The Glass Industry
REG. U. S. PAT. OFF.

Vol. 7 MARCH, 1926 No. 3

# American Ceramic Society's Annual Meeting

## Large and Successful Gathering at Atlanta, Georgia

### By J. B. Krak, Technical Editor

The 1926 meeting of the American Ceramic Society, held at the Biltmore Hotel, Atlanta, Georgia, during the week of February 8, will be remembered by many members of the Society as one of the most successful and enjoyable of the meetings ever held by this organization. Hundreds of members, many of whom had traveled long distances, gathered to discuss their problems and the progress of their industry during the past year, to listen to papers presented to the various divisions of the Society, to meet old friends and to make new acquaintances, and to take part in the social activities planned for the occasion.

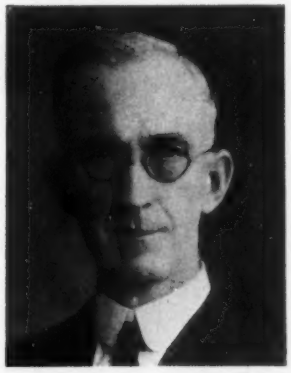
A large number of papers were contributed by technologists, engineers, executives and scientists actively engaged in the various industries covered by the American Ceramic Society.

The majority of the members attending the meeting arrived during the forenoon of February 8, and gathered in the spacious lobby of the Biltmore Hotel for registration. The sessions were opened by a general meeting held in the ballroom where the members were welcomed by W. D. Anderson, representing Governor Clifford Walker and by M. L. Brittain, President of Georgia Institute of Technology. The gathering was then addressed by Charles H. Herty, former President of the American Chemical Society and for many years Editor of *Industrial and Engineering Chemistry*, now president of the Synthetic Organic Chemicals Association. Dr. Herty, who is a native of Georgia, in an eloquent and witty address, referred to the great debt owed by the ceramic and glass industries to scientific discoveries, brought to the attention of the members the splendid opportunities for their industries in his native State and made a plea for the establishment of proper educational facilities as a means of developing the treasures with which nature has endowed the State of Georgia.

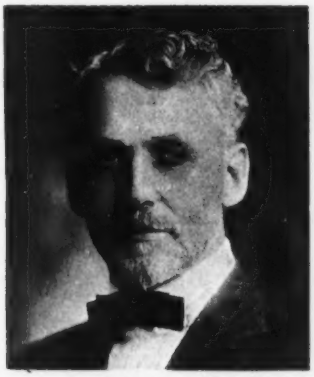
The next speaker was E. Ward Tillotson, Jr., of the Mellon Institute, of Pittsburgh, President of the Society, who outlined the activities of the past year. Although the membership continues to show a healthy growth, yet it had been necessary to curtail some important lines of work due to lack of funds. A considerable saving was effected by having

### Officers of the Society—1926-1927

R. L. CLARE
President



H. B. HENDERSON
Treasurer



ROSS C. PURDY
General Secretary

the *Journal* printed in Menasha, Wisconsin. Unfortunately the past year showed a small deficit. Recommendations were made to extend the membership and to increase the number of corporation members.

Hon. Frank West, President of the Ceramic Society of England then addressed the meeting on the Importance of Research to the Manufacturer of Refractory Materials and emphasized the point that each industry should carry the expense of collective research work by which it is to be developed.

Then followed an address by Albert V. Bleiniger entitled: "Limits of Our Knowledge of Ceramic Materials," and the reading of the Annual Report by the Secretary, Ross C. Purdy.

After the recess for dinner a large group of members and their friends congregated in the ballroom to listen to an address by Alexander Silverman, head of the Department of Chemistry, University of Pittsburgh entitled: "Glass, One of Man's Blessings." This lecture was illustrated with lantern slides and while delivered in a popular vein it contained much of interest. This was followed by motion pictures of glass making at the Corning Glass Works, by J. C. Hostetter.

The general officers of the American Ceramic Society elected for the ensuing year at this meeting were the following:

### New Officers for 1926-1927

President: R. L. Clare, Federal Terra Cotta Company, Woodbridge, N. J.
Vice-president: B. Mifflin Hood, B. Mifflin Hood Brick Company, Atlanta, Ga.
Treasurer: H. B. Henderson, Standard Pyrometric Cone Company, Columbus, O. (re-elected)
Ross C. Purdy will continue, as usual, to fill the office of general secretary.

### New Officers of the Glass Division

The officers of the Glass Division for the ensuing year elected on Wednesday, February 10, were the following:

Chairman: F. C. Flint, Hazel-Atlas Glass Company, Washington, Pa.
Vice-chairman: C. H. Modes, Illinois Glass Company, Alton, Ill.
Secretary: A. N. Finn, Bureau of Standards, Washington, D. C.
Trustee: J. C. Hostetter, Corning Glass Works, Central Falls, R. I. (re-elected)

### New Officers of Refractories Division

Chairman: R. F. Geller, Bureau of Standards, Washington, D. C.
Vice-chairman: L. C. Hewitt, Laclede-Christy Clay Products Co., St. Louis, Mo.
Secretary: L. J. Trostel, General Refractories Co., Rockdale Works, Joliet, Ill.

The 1927 Annual Meeting of the Society will be held at Detroit, Mich.

### Divisional Meetings

Tuesday and Wednesday were entirely devoted to meetings of the divisions: Art, Enamels, Glass, Heavy Clay Products, Refractories, Terra Cotta and White Wares. The technical sessions lasted from 9 A.M. until late in the afternoon with a short recess for luncheon. The lively discussions of the papers were continued during lunch and dinner, and at gatherings in the lobby of the hotel.

The meetings of the Glass Division, held in a room on the mezzanine floor under the leadership of Dr. Silverman were well attended. On Wednesday afternoon a joint session was held with the Refractories Division.

The papers presented to the Glass Division were, with a few exceptions, as listed in the program printed in the February issue and the number was so large and covered such a wide range of subjects that limitations of space do not permit an abstract of every one of them in this issue. For this reason brief summaries of some of the papers are given below; abstracts of the others will follow in a later issue.

## Officers of the Glass Division—1926-1927

F. C. FLINT
Chairman

C. H. MODES
Vice-Chairman

A. N. FINN
Secretary

J. C. HOSTETTER
Trustee

### Glass As a Factor in Civilization

By ALEXANDER SILVERMAN, PITTSBURGH, PA.

The opening address, delivered before the Glass Division by the Chairman included a rapid survey of the development of the glass manufacturing industry from its earliest beginnings until the present day. The speaker opened his address with the commentary on wisdom from the Book of Job: "Gold and glass cannot equal it, neither shall the exchange thereof be vessels of fine gold," indicating the extreme high regard in which glass was held in antiquity. Mention was made of the fact that Chinese writings refer to the telescope for the study of the heavens, of the discovery of glass bottles, flasks and bowls used in ancient Egypt and of early mirror manufacture during the time of Aristotle.

Theophilus, an Anglo-Saxon monk was mentioned as the first man known to have blown window glass cylinders; d'Amati of

Florence was the inventor of spectacles; de Nehon was the first mirror manufacturer in France. His son first rolled plate glass at Saint Gobain in 1688. Robinet in 1824 used an air pump for blowing glass and in 1855 Petitjean gave us our modern process for silvering mirrors. Guinaud operated the first optical glass works and Frauenhofer, the inventor of the spectroscope, laid the foundation of a new branch of science and was the first to define the effects of chemical composition of various glasses on their physical properties.

The speaker then referred briefly to the early achievements in glass making in England, Germany, Bohemia and Holland, and turned to an outline of the history of American glass manufacturing.

The first industrial enterprise in the American colonies was a glass factory for the production of bottles established in the Colony of Virginia near Jamestown in 1607. Later many other factories were built, at Sandwich, Mass. and the Stiegel plants near Lancaster, Pa. In 1796 Craig and O'Hara operated the first coal-fired furnaces in Pittsburgh for the manufacture of hollow ware, bottles and window glass. The Siemens furnace was introduced and improved by Nicholson, Gill and others in the natural gas region about Pittsburgh in 1872. Plate glass manufacture originated at Creighton, Pa.. The development of the Owens bottle machine, the manufacture of wire glass and the sheet glass processes of Colburn and of Fourcault were sketched. Mention was made of Thomson's work on fused quartz. The speaker finally discussed the profound influence which the extensive use of glass has had on practically every department of human activity, from its early use in telescopes until its latest application in radio bulbs, as a means of securing greater comforts and pleasures, and above all, as a means of obtaining a deeper insight in the secrets and beauty of nature.

---

E. W. Washburn, of the National Research Council, being absent the report of the Research Committee was read by the Secretary, A. N. Finn. Satisfactory progress was reported.

---

## Fundamental Requirements for Annealing Glass

By A. W. Finn, Washington, D. C.

The rapid reduction of the temperature of glass produces strains which must be removed to render glassware satisfactory for commercial purposes. This removal is called annealing or tempering.

Knowledge of the annealing temperature is a first requirement. If the ware is heated too much, it will lose its shape. If annealing is done at too low a temperature, an excessive amount of time is needed for annealing.

The methods depending on the location of the region of abnormal heat absorption and the measurement of the variation of the expansivity with temperature were proposed for the determination of the annealing range.

Although stresses in glass are released very quickly at the maximum temperature of the annealing range, it does not follow that this will be best suited for expeditious work. Very thin ware can be cooled rapidly, but the safe cooling rate decreases materially as the thickness increases, however, annealing temperatures permit a more rapid cooling rate, which more than compensates for the increased time for annealing.

The selection of the annealing temperature should be governed by the thickness of the ware. The rate of cooling depends on the temperature from which the glass is cooled and its thickness. As the temperature falls, the rate can be increased so that after the temperature has dropped about 35° C. (63° F.) it may become twice as great, and finally after a drop of 100° C. (180° F.) the rate per hour may be further increased. After cooling below 400° C. (752° F.) the rate may be increased still more without danger of introducing permanent strain, unless the temporary strain developed exceeds the strength of the glass.

Pyrometric temperature control is of great help to obtain perfect annealing. The greater the uniformity in the temperature from side to side and from top to bottom of the lehr, the better the annealing will be.

Strain in glass is easily detected by means of the strain finder. If a piece of strained glass is placed in the beam of light between the polarizer plate and the nicol, parts of the glass will apparently be colored differently than the original field. If well annealed glass is examined, practically no change in color is seen. If a highly strained piece of glass is observed, the colors will be vivid.

Some ware having an irregular shape cannot be examined satisfactorily without putting it into a tank made with two plate glass windows and containing a liquid whose index of refraction is as near as possible to that of the glass being tested. Monochlorbenzene is satisfactory for soda lime glass.

Glass should be annealed to a degree compatible with the purpose for which it is used. Large pieces require more careful annealing than smaller ones. Hollow ware should be well annealed since it is repeatedly washed with hot water and then cooled rapidly. Plate and window glass might be stronger if it were not completely free from permanent strain, since it would be better able to withstand wind pressure.

The most satisfactory method for controlling the effectiveness of the annealing operation is by the use of standard samples. Comparison of the daily work with such standards give a definite idea of what is going on in the lehr and will aid to determine and maintain satisfactory annealing conditions.

---

## History and Recent Progress in Manufacture of Plate Glass

By J. W. Cruikshank, Pittsburgh, Pa.

The speaker gave a review of the history of plate glass manufacture in Europe and outlined its development in the United States. Plate glass was first made at Creighton, Pa., then at Tarentum, and subsequently at Ford City. These factories were later combined into the Pittsburgh Plate Glass Company in 1899. The Edward Ford Plate Glass Company was built in Toledo, Ohio and has developed into one of the important producers of plate glass.

Originally the sheets of glass were 20 square feet in area. At present they measure 400 square feet. The object is always to produce the larger sizes as they are most profitable. However, large sizes often show thin and heavier spots which are difficult to grind down.

The water-cooled table was a great step forward. Since the table will always warp to some degree, it is necessary to produce glass not less than 7/16 inch in thickness. If it is attempted to make thinner glass, breakage nearly always ensues.

Richereau was mentioned as the inventor of a new continuous process developed abroad. The molten glass is poured into a hopper and thence flows to a moving table, which brings it under continuous grinding and polishing machines.

The speaker then outlined the continuous process in use at the River Rouge plant of the Ford Motor Company, the process developed by the Pittsburgh Plate Glass Company and the production of plate glass in connection with Fourcault and Libbey-Owens sheet glass machines. The opinion was expressed that the Fourcault sheet glass was more absolutely flat and true than the product of the Libbey-Owens machines. Both methods require extremely careful temperature and batch control to avoid devitrification. In this country the Fourcault process has encountered serious difficulties. The glass shows parallel lines, which however disappear upon grinding and polishing.

---

## Comparison of Glass Manufacturing Methods in Various Countries

By Robert L. Frink, Lancaster, Ohio

The salient fact brought out by the speaker was to the effect that the successful introduction of American glass making machinery depends on a thorough factory re-organization. Inventors, manufacturers, and suppliers of automatic machinery have spent much time and money to send their mechanics over to European countries to set up and operate their machines, but these men have little or no knowledge of factory organization necessary for the successful solution of the problems encountered. They do not realize that such organization must become co-ordinated with the new methods required by the introduction of machinery. The speaker emphasized the point that the American supplier does not intentionally neglect his obligations and business interests, and that mediocre success of American machinery abroad is the result of lack of understanding of the situation with which one is confronted in foreign glass factories. A plea was made for a better knowledge of conditions as a prerequisite for the establishment of permanent and profitable relations.

## The Application of Electric Heat to Glass Annealing

BY A. N. OTIS, SCHENECTADY, N. Y.

The first electrically heated lehr[1] to be used on a commercial scale, was installed in the vacuum tube department at the Schenectady Works of the General Electric Company in 1920 (Fig. 1). This lehr consists of a relatively short horizontal heated chamber, elevated at some distance above the floor, with a vertical connecting chamber at each end, through which the ware passes to enter and to leave the horizontal heated chamber.

The entrance side is provided with heaters for preheating the

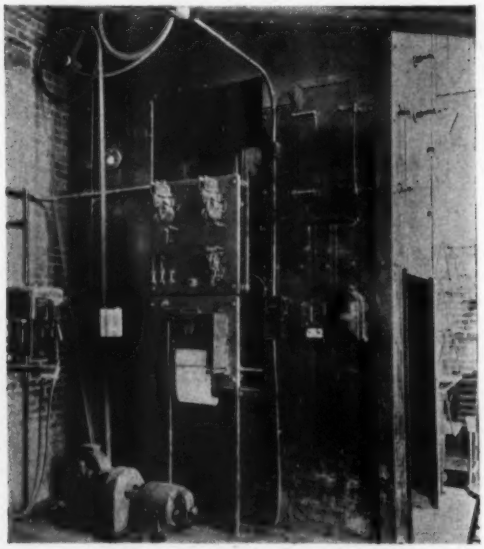


FIG. 1. ELECTRIC LEHR FOR VACUUM TUBES, ETC.

ware and conveyor, while the exit side forms a part of the cooling space.

The ware is carried in swinging trays 30 inches long by 8 inches wide, which may be hung from the cross bars of a continuous conveyor, the trays being modified in detail to support a variety of ware.

This lehr has been in operation over five years, annealing various

FIG. 2. SAME TYPE AS FIG. 1 BUT LARGER (Under construction)

sizes of vacuum tubes, X-ray tubes, supporting stems, etc. Most of this ware is relatively thin and consists of a body to which stems, supports, or other inwardly or outwardly projecting parts have been attached by fusing. Examination with a polariscope shows that the strains at these joints, as well as other parts of the ware, are entirely removed, and that the ware is completely and uniformly annealed.

[1] For detailed description consult "Electrically Heated Glass Annealing Lehrs," THIS JOURNAL, Vol. 2, No. 5 (May, 1921) pp. 107-109.

From 30 to 70 X-ray bulbs are annealed per hour, depending on the size.

A new lehr of the same type (Fig. 2), but considerably larger, is being built, the heating chamber being approximately 27 feet long and 5 feet wide.

An electrically heated lehr for annealing miniature lamp bulbs in bulk was installed at the National Lamp Works, Cleveland, Ohio, early in 1921. It was put in operation in April of that year, and has been in constant use since.

The inside dimensions are 16 feet long, 30 inches wide and 24 inches high. The bulbs are carried through in pans by

FIG. 3. CONVEYOR TYPE FURNACE FOR ANNEALING BULBS

means of an intermittent hand operated conveyor. The lehr is shown in Fig. 3. The connected load is 60 kw., divided into two automatically controlled heat zones, and the output is from 15,000 to 50,000 bulbs per hour depending on the size, with an average power consumption of 42 kwh. per hour.

The bulbs are carried through in sheet metal pans or trays,

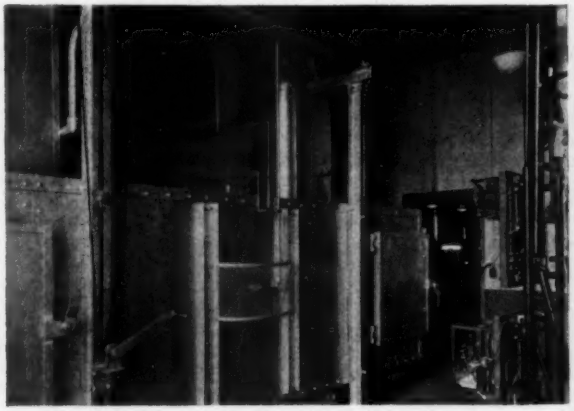


FIG. 4. FURNACE FOR ANNEALING MINIATURE LAMP BULBS

filled to about two inches thickness, and require two hours for the annealing cycle.

These bulbs are blown from glass tubing by automatic machines, and most of them are sealed in the cutting-off process, so that the interior is under a partial vacuum. The walls are very thin, while the necks are fairly heavy, and being piled on top of each other in trays, and containing a partial vacuum, they are extremely sensitive to annealing.

It is conservatively estimated that a direct saving of 20 per

cent in the manufacture of bulbs results from the perfect annealing secured with this lehr, as rejections and grinding have been eliminated, and further that much greater savings are secured in the processes of assembling into lamps, since well annealed bulbs show much less tendency to breakage than strained or unevenly tempered bulbs. Many millions of bulbs per year are annealed in this lehr, of a quality and uniformity which is quite remarkable.

A somewhat similar lehr for annealing filament stems has more recently been installed at the Illinois Miniature Lamp Division at Chicago (Fig. 4), and has produced equally satisfactory results. In this case the pans are stacked above each other in suitable racks, upon which they are pulled through the lehr.

These installations, while not large, have demonstrated the value of electric heat where exacting conditions have to be met, and it is stated by those in charge of this work that they would prefer the most accurate heat control obtainable, regardless of annealing cost, since the cost of annealing is only one to two per cent. of the value of the annealed ware.

The most outstanding application of electric heat for annealing commercial glassware has been made by the Illinois-Pacific Glass Company at San Francisco.[2] This company has had electrically heated lehrs in operation for several years, beginning in a modest way and gradually extending, until in the very near future the entire output of their plant will be annealed electrically.

The product is bottles of various sizes and shapes, and the lehrs are of the usual horizontal traveling conveyor type, so that this plant is representative in product and equipment of many glass plants.

From records that have been kept it is shown that the current consumed is well within the limits that might be expected. The following data are given:

CURRENT CONSUMED

Output of 9 ft. lehr for seven days continuous operation

Bottles 16 oz. capacity—12 oz. weight.

Annealed during week 29,879 dozens or 2,482 gross.

| | |
|---|---|
| Total power consumed | 11,010 KWH. |
| KWH. per gross | 4.43 |
| Total weight annealed | 273,500 lbs. |
| Lbs. per KWH. | 24.85 |
| Average lbs. per hour | 1,625 |
| Average KWH. per hour | 65.5 |

This shows the average input and output, from which the cost of operation can be readily computed when the power rate is known. For example, at 1 cent per kwh. the power cost for annealing would be 4½ cents per gross, or approximately 25 pounds of ware can be annealed for one cent. This will vary with the size of bottles and density of loading. The output given above, namely, 1,625 pounds per hour, is considerably less than the capacity of the lehr which can handle more than 2,000 pounds per hour.

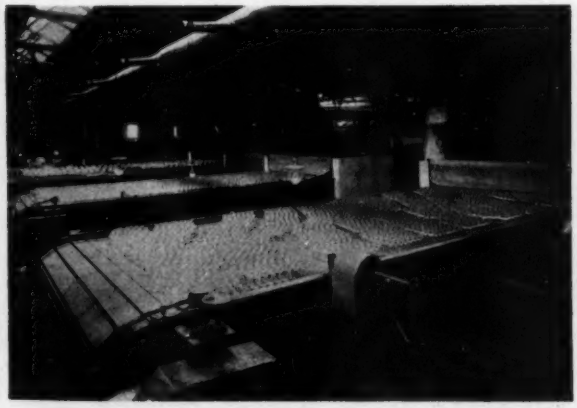


FIG. 5. EXIT ENDS OF THREE ELECTRIC BOTTLE LEHRS

A view of the exit ends of three of these lehrs is shown in Fig. 5.

Studies have been made of annealing lehrs for sheet and plate glass, and designs have been worked out which appear entirely practicable, although no applications have yet been made.

The annealing of optical glass has always been a difficult process, due to the uncertainty of maintaining the correct cooling rates. With electric heat and suitable control equipment it is possible to control these rates with certainty, and to a large extent automatically, so that results can be duplicated time after time.

A box furnace 24 inches wide, 4 feet 6 inches long, 20 inches high, of the type shown in Fig. 6, has been in use for some months for annealing lenses and prisms. The parts are suitably packed in cast iron boxes, and the furnace chamber is nearly filled with the boxes. The boxes combined with the firebrick lining of the furnace affords a considerable mass and heat storage capacity which has the effect of delaying the rate of temperature changes in the glass.

A careful study has also been made of the problem of annealing large glass discs for telescopes. As is well known, the requirements for this work are exceedingly exacting.

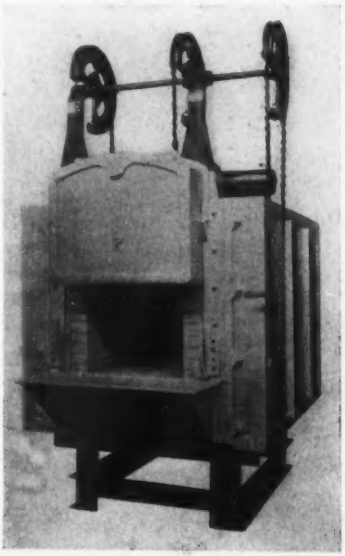


FIG. 6. ELECTRIC ANNEALING FURNACE FOR LENSES AND PRISMS

While the installations referred to have been chosen to show a wide variety of applications of electric heat, ranging from the annealing of bottles to optical glass, it is realized that the manufacture of bottles is a very large and important industry, in which a saving in the cost of manufacture would represent a very considerable economic gain.

The results of several years of operation have shown that substantial savings in the cost of manufacture can be realized and that electric heat is particularly well adapted to traveling conveyor lehrs. The reasons may be summarized as follows:

1. Ware perfectly and uniformly annealed, eliminating rejects and increasing output.
2. Ware clean and sterile.
3. Elimination of attendance.
4. Elimination of or greatly reduced maintenance.
5. Mild and uniformly distributed source of heat.
6. Automatic control maintains exact temperature curve.
7. Temperature curve can be adjusted to any desired values for different kinds of ware.
8. Correct temperatures maintained regardless of loading.
9. Possibility of shortening annealing cycles due to accurate temperatures, thereby using shorter lehrs, saving in cost and floor space.
10. Extremely desirable load from the standpoint of the power company, being continuous and of high power factor.

[2] For detailed description consult THIS JOURNAL, Vol 6, No. 8, August, 1925, pp. 161-164.

## Wearing Away of Tank Blocks

BY DONALD W. ROSS, WASHINGTON, PA.

As a rule the wearing away of tank blocks in glass melting furnaces takes place primarily by direct solution. Glass dissolves the exposed block surfaces and forms a clay bearing glass.* This clay bearing glass is heavier (has a higher specific gravity) than normal glass, and where opportunity offers, it readily sinks. Dissolving of the blocks proceeds in proportion as the clay bearing glass is removed. However, if the clay bearing glass is not removed from a given portion of tank block surface, such glass, at and near such surface, becomes saturated with clay and further solution of the surface practically ceases.

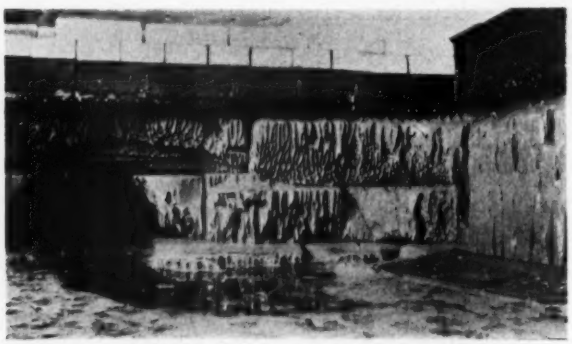
The clay bearing glass forming at the tops of blocks tends to flow down over the vertical faces of the blocks and protects them. Wherever there are horizontal joints between the blocks or defects in the surfaces of the blocks, that glass can get into, the above described coating does not occur and rapid solution of the blocks takes place. The resulting clay bearing glass settles on the lower (upward facing) surfaces of such openings after which reaction practically ceases thereon. However, the clay bearing glass readily runs off the upper (downward facing) surface of such openings and extremely rapid solution of the block ensues.

This upward eating from horizontal joints and defects apparently results in more eating away of the block than all other causes.

Such upward eating is characterized by circular holes approximately ⅜-inch in diameter which are drilled vertically upward, and which apparently greatly accelerate solution of the block. Such holes have been ascribed as possibly being due to surface tension effects in conjunction with chemical reaction.

Of course if the block is not well bonded together, pieces of it may become dislodged and floated away, or if the face of the block shrinks much in use cracks may open up in it, but in either case, glass gets into the defects and rapid upward eating of the block ensues.

As a general rule solution of blocks is less at the bottom of tanks that are 60 inches deep than in tanks that are 42 inches deep and less in 42-inch tanks than in tanks that are but 30 inches deep. Or in general then the deeper the horizontal joints are below the surface of the glass, the less will they be eaten. Thus we may expect less eating at the horizontal joint between



EFFECTS OF UPWARD EATING FROM HORIZONTAL JOINTS
Bridge wall of bottle glass tank.

THESE TWO BLOCKS SIDE BY SIDE IN SERVICE
The face of the left hand block did not crack and showed practically no eating. The face of the right hand block shrunk and cracked badly in use, upward eating started in these defects and practically half the block was dissolved away; side wall blocks, bottle glass tank.

UPPER SIDE WALL BLOCKS
Largely eaten away, above horizontal joints, by effects of upward eating. Lower side wall blocks practically unaffected, having been protected by clay-bearing glass settling on them; side wall of bottle glass tank.

* Some aspects of Tank Block Corrosion, by S. R. Scholes, GLASS INDUSTRY, Vol. 5, No. 9, September, 1924.

the bottom and side walls than at horizontal joints in the side walls themselves.

Special or unusual conditions such as large quantities of salt water or similar substances on top of the molten glass under reducing conditions, bring about special effects on the blocks, such as eating at and near the glass line. Such conditions as they become better understood are being rapidly eliminated by glass manufacturers, and being of a local character do not apply generally to the dissolving away of tank blocks.

Longer tank life then would appear to be favored by the production by tank block manufacturers of blocks having a minimum of shrinkage after being placed in the tank, and containing a minimum of mechanical defects that the glass can get into.

VERTICAL SECTION OF GLASS FILLED HOLES THAT FORM VERTICALLY UPWARDS IN TANK BLOCKS

Such holes characterize upward eating of blocks and are probably one of the principal factors making for rapid solution of blocks; side wall bottle glass tank.

It would further appear that the tank block user can himself favor longer tank life by the elimination of horizontal joints between blocks.

This elimination of horizontal joints might even be carried to its logical conclusion and eliminate the horizontal joint between bottom and side walls by having the side wall blocks project down the side of the bottom blocks instead of resting upon them.

Constant care by the glass man during heating up of glass tanks is worthy of his careful consideration. For, cracks formed in the blocks through careless heating may be expected to appreciably decrease the life of the tanks.

---

## Chemical Composition of Window Glass

BY EDWIN P. ARTHUR, COLUMBUS, OHIO

Success in the manufacture of window glass depends largely on the selection of the proper chemical composition of the glass, in connection with the requirements of the glass forming machine. Machinery cannot accommodate variations in physical characteristics as did workmen who made window glass by hand. Consequently a more uniform melt is required for the successful operation of glass making machinery than was necessary in the past in a hand plant.

The number dots within the shaded area in Fig. 1 refer to the table, which shows the approximate composition of five window glasses manufactured in different ways. The percentages in the table were calculated from typical analyses of glasses by deducting the total of minor constituents from 100 per cent and recalculating the percentage of silica, lime and alkali of the remainder. The best present practice for window glass composition would seem to fall in a rather limited field. The different glasses are,

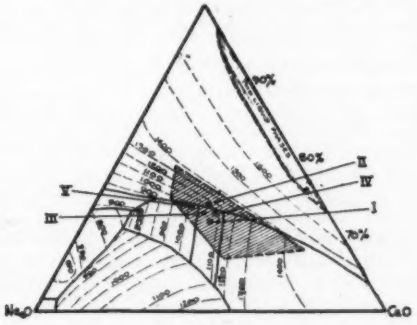



FIG. 1

nevertheless, distinct from each other as the glass making machines are sensitive to a surprising degree.

CHEMICAL COMPOSITION OF WINDOW GLASSES

| Method of Manufacture | 1 Hand-Made | 2 Lubbers | 3 Slingluff | 4 Colburn | 5 Fourcault |
|---|---|---|---|---|---|
| $SiO_2$ | 71.9 | 74.3 | 73.1 | 72.8 | 73.8 |
| CaO, MgO | 14.2 | 12.6 | 14.2 | 13.1 | 11.1 |
| $Na_2O$ | 13.9 | 13.1 | 12.7 | 14.1 | 15.1 |

One of the principal manufacturing difficulties, especially with the Colburn and Fourcault machines, arises from a tendency of the glass to devitrify. If glass is cooled to reach a proper viscosity for working, some component of the melt may crystallize

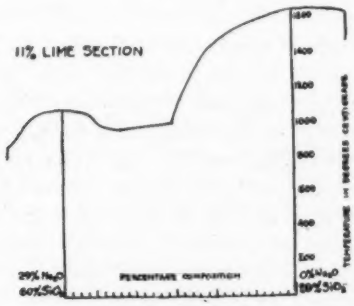



FIG. 2

introducing opaque masses into the sheet, thus forming highly objectionable defects in the finished ware.

Recent work of Morey and Bowen is of interest in this connection. They determined the crystallizing points of the three component system $SiO_2$, CaO, $Na_2O$ by a series of fusions and quenchings. Their results, shown in Fig. 1, set the temperature limits very definitely beyond which devitrification will take place, disregarding the effect of minor constituents which may be in commercial glass as above.

In Fig. 2 is shown a two-component section through the Morey-Bowen diagram at the line of 11 per cent CaO. It is readily seen that the composition for a durable glass which can be cooled to the low point without devitrification is about 15 per cent $Na_2O$ and the minimum temperature about 1000°C, facts entirely confirmed by practice. For example, such a glass as mentioned will work well at 993°C, while a variation of 10° is known to cause considerable difficulty. It is seldom that the results of so-called pure research so exactly coincide with practice.

A two-component section at 72 per cent $SiO_2$ was shown. A glass such as the hand-made window glass No. 1, containing 14 per cent CaO and 72 per cent $SiO_2$, is generally worked and quickly cooled from temperatures near 1150°C (2100°F).

### Among Those Present at the Glass Division Meetings

The official registration of the Glass Division showed the presence of the following members. Numerous others attended the meetings from time to time.

Alexander Silverman, University of Pittsburgh.
A. N. Foster, chief of Glass Section, Bureau of Standards, Washington, D. C.
Volney Foster, United States Silica Company, Chicago, Ill.
J. F. Littleton, Corning Glass Works, Corning, N. Y.
A. R. Payne, Hazel-Atlas Glass Company, Clarksburg, Pa.
F. B. Garrod, Owens Bottle Company, Toledo, O.
Edwin P. Arthur, Ohio State University, Columbus, O.
William A. McCleary, Jefferson Glass Company, Follansbee, W. Va.
J. M. Zander, Western Electric Company, Chicago, Ill.
W. A. Koehler, University of West Virginia, Morgantown, W. Va.
M. R. Scott, Bausch & Lomb Optical Company, Rochester, N. Y.
R. F. Brenner, Vitrolite Company, Parkersburg, W. Va.
George Aurien, Pennsylvania Wire Glass Company, St. Louis, Mo.
C. H. Modes, Illinois Glass Company, Alton, Ill.
W. F. Curtis, Fostoria Glass Company, Moundsville, W. Va.
Geo. Blumenthal, *Ceramic Industry*, Chicago, Ill.
M. J. Babcock, Pittsburgh Plate Glass Company, Pittsburgh, Pa.
R. L. Frink, Lancaster, O.
A. H. Sullivan, St. Louis, Mo.
D. A. Scullin, of A. H. Sullivan, St. Louis, Mo.
A. N. Otis, General Electric Company, Schenectady, N. Y.
Fred S. Thompson, Pitney Plant, General Electric Company, Cleveland, O.
C. E. Parmelee, Pittsburgh Plate Glass Company, Pittsburgh, Pa.
G. E. Merritt, Bureau of Standards, Washington, D. C.
C. O. Fairchild, Bureau of Standards, Washington, D. C.
Garland Lufkin, Illinois Glass Company, Alton, Ill.
J. W. Cruikshank, J. W. Cruikshank Engineering Co., Pittsburgh, Pa.
J. C. Hostetter, Corning Glass Works, Central Falls, R. I.
H. L. Watson, General Electric Company, Lynn, Mass.
J. B. Krak, GLASS INDUSTRY, New York.

### Exhibits Arouse General Interest

An interesting features of the meeting was a number of exhibits of ceramic products, materials and equipment, which were located in rooms on the first floor and on the ground floor of the hotel. They were attractively arranged and proved to be of considerable interest to the members, many of whom expressed the wish that such exhibits may become an established feature of the annual meetings of the Society.

Among those represented were:

The Bristol Company, pyrometers, Waterbury, Conn.
Roessler & Hasslacher Chemical Co., glass and ceramic materials, New York.
Simplex Engineering Company, glasshouse engineers, Washington, Pa.
Brown Instrument Company, pyrometers, Philadelphia, Pa.
Leeds & Northrup Company, pyrometers, Philadelphia, Pa.
A. H. Sullivan, "Missouri" silica sand, St. Louis, Mo.
Thwing Instrument Company, pyrometers, Philadelphia, Pa.

# The Manufacture and Use of Cullet

**By D. J. McSwiney***

I have been in glass plants where an observation of the filling operation would lead one to believe that the glass was being made of nothing but cullet plus the dirt and oil swept up around the machine. All glass factories make cullet, but the amount made varies considerably in different plants. The size of the cullet pile is usually controlled by the amount of cullet used with the batch and most glass makers are complacent towards the constant possession of this dubious asset so long as they can keep the pile from growing without using with the batch an amount of cullet greater than that which is considered allowable.

This is because the majority of glass makers feel that the use of some cullet is necessary for successful glass manufacture, and that so long as they can remelt the cullet, the loss is slight. However, this is not the case; glass can be made, and at times is made, as well, if not better, without cullet as with it. In fact many glassmakers who believe most firmly in the necessity of using cullet actually melt their batch without it. This is especially true in the manufacture of flat glass, where in the majority of cases the batch and cullet are filled into the tank separately, a large pile of batch being filled in and followed by a pile of cullet. In this case where there is little or no mixing of the batch and cullet attempted, the melting of each of these materials can have little or no influence on the melting of the other, or on the glass formed from it. While the remelting of cullet may occasion little or no loss of glass materials, its manufacture results in a greater loss in the cost of labor, fuel and equipment used in making and handling it.

The action of various amounts of cullet in glass has never been thoroughly investigated and the exact effect of its use on the nature of the glass is unknown. It is known, however, that the use of excessive amounts of cullet in many cases decreases the efficiency of tank and machine operation by decreasing the rate of refining, thus increasing the tendency to seed, and by increasing the breakage. It happens occasionally that a glassmaker with an inflated cullet pile in attempting to reduce it to normal size by increasing the amount used with the batch, is surprised to find the pile growing larger.

Glass made by melting cullet alone differs in its working properties from glass made directly from the batch. It is probable therefore, that the use of cullet tends to form a non-homogeneous glass unless the molten cullet is thoroughly mixed with the products of batch fusion by the vigorous gas agitation which obtains during the first stage of the melting, or unless the pull is so low that the tank of glass cooks long enough to allow diffusion to render it uniform. This thorough mixing can take place only when the cullet is fine and is well mixed with the batch. Even where there is used what is ordinarily considered a normal amount of cullet, there is no particular evidence that its use is an advantage, except in special cases.

It is often stated that the cullet used with the batch acts as a flux. It is difficult however, to see how this can be so; it cannot act as a flux towards the sand as it is already near its saturation point in this ingredient, and cannot either take up more or act as a medium for the combination between the sand and the other batch ingredients. It will readily combine with molten soda ash but this material needs

*Consulting chemist, Columbus, O.

no fluxing action. It can take up lime if its lime content is not already high, but this is the case only in bottle or similar glasses of low lime content, and in these cases the lime should not need a flux.

It is probable that the cullet acts, not as a flux, but merely as a diluting material, and by tending to prevent the agglomeration of particles of sand, lime or other materials, the assimilation of which is slow near the end of the melting process, it decreases the tendency for the formation of batch scum. However, the same effect could be gained more advantageously by filling the batch in smaller piles and scattering the piles throughout the back of the tank.

Cullet should not be considered a necessary evil of the glass industry—at least not to nearly the extent it is at present considered to be. Instead of manufacturing glass with a view of allowing to be made at the same time enough cullet to supply the batch with the amount which it has been a habit to use, real effort should be made to decrease the amount of cullet from any source to a minimum. A few glassmakers have so succeeded in this respect that they need use only 400 lbs. or less of cullet to a ton of sand to prevent accumulation, but the great majority of factories making similar lines of ware must use from two to four times this amount to keep the cullet pile from growing.

Some cullet is necessary for starting up a new tank or pot, as the corrosive action of batch on clay refractories is very much greater than that of glass; however, the amount required for this purpose is less than that left in the tank when it goes out. Considerable cullet results from the wasteful practice of using hot glass to bring the molds to the forming temperatures, and more than is necessary is made by running off too great an amount in clearing a spout or trough. The greatest source of cullet, and the most costly, is that resulting from off-ware.

The amount of off-ware will, of course, depend primarily on the kind of ware being made and on the way in which it is formed, but it will also depend to a very great extent on the intelligence with which the forming means is operated and on the suitability of the glass for the type of ware and machine for which it is used.

To a great extent, the glass and forming means are complementary. There is no universally best glass as far as working qualities are concerned, but on the contrary, there is a glass of a particular character which will give the best results obtainable for each type of ware and forming means.

This fact should be obvious but it is very often overlooked. Much loss has at times been suffered by attempting to adapt to some machine a glass batch which has given good results when worked by hand or on some other machine operating on different principles. For example, what is desirable for hand worked ware is a glass which is fairly viscous at the gathering temperature, so that it can be easily and quickly gathered, but which sets rather slowly so as to allow time for the comparatively slow process of hand forming without repeated reheating; that is, a glass with a fairly long working range. However, such a glass will not work efficiently in a rapid forming machine such as an Owens' bottle machine, for which there is needed a glass which is quite fluid at the working temperature so that it can be drawn into the blank in such a way as to quickly and completely fill the finish, and which will set at such a rate that the paraison will, within a very short space of time, acquire sufficient rigidity to allow it to maintain its shape and hold to the neck ring when the knife is withdrawn and the blank mold opened, and at the same time allow rapid and uniform blowing. That is for this purpose, a fluid glass with a medium short working range gives the best results.

It too often happens that a batch which has been giving average good results is changed for the purpose of cheapening it, without proper consideration of the effect of the change on the production of off-ware. Few glassmakers are competent to judge beforehand the effect of a change in the composition of their batch on the way the glass will machine and anneal. With some types of ware, an increase of one or two per cent in the amount of off-ware made can more than offset a saving of ten per cent in decreased cost of the batch.

Most glass plants do not have detailed cost systems which would allow them to see the actual cost of making and handling cullet, or the ratio between the cost of the batch and the loss occasioned by the off-ware formed at various steps in the manufacture, so that, while the cost of the batch is easily determined, the cost of the off-ware is rather intangible. As a matter of fact, most glass plants do not know the percentage of off-ware produced from each type of ware they manufacture, but merely know roughly the entire amount of cullet produced from all the jobs made, from the ratio of the amount of cullet used in the batch to the apparent size of the cullet pile.

The speed of glass forming machines is controlled as is also the glass temperature, although the control of the latter is often very rough. However, these are not the only factors which influence forming efficiency. For example, the temperature of the molds, especially that of the blank mold is probably as important as the temperature of the glass itself and is seldom more than very roughly controlled—if the mold runs so hot that mold marks or other signs of hot molds become excessive, more air is turned on them, and similarly, if off-ware from cold molds become too numerous, air is taken off the molds. Normally, the mold temperatures may be at any point within this wide range, although there is for each job a temperature at which the forming will be most efficient.

It is seldom if ever the case that a glass forming machine, such as a bottle blowing machine is worked at its highest efficiency. The output of good ware from two different plants making the same kind of ware on the same types of machines will often differ greatly; in some cases one plant will turn out from thirty to one hundred per cent more ware per machine, and with no greater a percentage of off-ware, than another plant making the same ware on machines of the same make and size.

The only solution of the problem lies in a careful record of the amount of off-ware of each type formed from every different job, at each step in the manufacturing process, and under set conditions of temperature, machine and lehr operation; an intelligent determination of the causes of the off-ware formation in each case, and a careful variation of operating or glass conditions to eliminate these causes as far as is possible.

# Glass Industry

ESTABLISHED 1920

The First Trade Journal Devoted Primarily to Glass Technology, Engineering, Raw Materials, and Glass Factory Equipment and Operation

Published Monthly

GLASS INDUSTRY PUBLISHING COMPANY, INC.
50 Church Street, New York

Telephones { Cortlandt 2465 / Cortlandt 5618 } Cable Address, Glasdustry

J. B. KRAK, Technical Editor

Subscription Price.....$2.00 a Year
Single Copy.....20 Cents

THE GLASS INDUSTRY circulates extensively among American and foreign glass manufacturers, their business executives and technical and factory operating staffs.

ADVERTISING RATES SENT ON REQUEST

Vol. 7 MARCH, 1926 No. 3


## CONTENTS


| | Page |
|---|---|
| American Ceramic Society's Annual Meeting | 59 |
| Abstracts of Papers Presented: | |
| Glass as a Factor in Civilization | 60 |
| History and Recent Progress in Manufacture of Plate Glass | 61 |
| Comparison of Glass Manufacturing Methods in Various Countries | 61 |
| Fundamental Requirements for Annealing Glass | 61 |
| The Application of Electric Heat to Glass Annealing | 62 |
| Wearing Away of Tank Blocks | 64 |
| Chemical Composition of Window Glass | 65 |
| The Manufacture and Use of Cullet | 66 |
| Editorial: | |
| Glass Makers and Coal Producers | 68 |
| Technical Consultation Service: | |
| Formula for Acid Etching Transfer Ink | 69 |
| International Capital in the German Glass Industry | 69 |
| Recent Patents | 71 |
| The Hartford-Empire Lehr | 73 |
| Glass Factory Equipment and Supplies: | |
| Bethel Feeder Now on the Market | 76 |
| New Tank Embodies Novel Features | 77 |
| Industrial Publications | 77 |
| The Glass World and What It Is Doing: | |
| H. L. Dixon Re-enters Refractories Field | 78 |
| January Plate Glass Production | 78 |
| Trade Activities | 78 |
| Personals | 79 |
| Recent Deaths | 79 |
| Coming Meetings | 79 |
| Inquiries Received | 79 |
| What the World Wants | 79 |
| Glass Stock Quotations | 79 |
| Current Prices of Glass-Making Materials | 80 |
| Monthly Summary of United States Foreign Commerce in Glass | 80 |

CLASSIFIED BUYERS' GUIDE, PAGE 24
INDEX TO ADVERTISEMENTS, PAGE 26


## Glass Makers and Coal Producers

A report of considerable interest to the glass industry and to all other industries depending upon fuel, was recently read by Howard N. Eavenson, Chairman of the Coal and Coke Committee before the annual meeting of the American Institute of Mining and Metallurgical Engineers, held in New York City. It was stated that the four principal fuels used in the United States are: bituminous coal, 73 per cent; anthracite, 11.5 per cent; fuel oil, 10.3 per cent; natural gas, 5.2 per cent. Of importance was the statement that the peak has been reached in the use of natural gas and fuel oil, and that many industries are turning to coal on account of the gradual failure of the natural gas supply and the high cost of fuel oil.

These facts, of course, are thoroughly understood by the glass manufacturing industry. Yet they bear restatement in view of the somewhat exaggerated importance which fuel oil has assumed in the minds of some manufacturers throughout the country.

It is admitted that fuel oil has superior advantages under certain conditions which overbalance its high cost. But for the bulk of the nation's glass supply we are now, and will be in the future, chiefly dependent upon manufactured gas. The glass industry therefore has a lively interest in the improvement of the various methods to convert coal into gas. At the same time glass makers are concerned in conditions existing in the coal producing industry. In spite of the assertion frequently made that the soft coal industry is the most over-developed one in the country, it is less over-developed than either copper or steel.

In view of the futility of the results obtained by the Federal Coal Commission, appointed in 1922, it is idle to expect improvements from outside sources. The coal industry must work out its own salvation and far be it from our intention to presume to indicate a way. It is of interest to note, however, how the coal industry in other countries of great manufacturing activity have met similar conditions. Elsewhere in this issue appears the statement that the Ruhr Glass Works near Essen, Germany, derives its fuel from the Matthias Stinnes collieries. The process for low temperature carbonization used in this instance is known to the very efficient. The new plant of the German Libbey-Owens Sheet Glass Company will obtain its fuel supply from the Dahlbusch colliery where gas is manufactured by a similar process.

That such projects require a large outlay of capital is obvious. However, if they are feasible in Europe, there cannot be any reasons of a financial nature that would prevent the building of such plants in the glass making centers of this country, especially since several of these are located in the heart of the finest coal fields in existence anywhere in the world.

We make the suggestion for what it is worth: that glass manufacturers, now dependent upon natural gas, and coal miners, suffering from an over-developed industry, may be able to solve some of their problems by intelligent co-operation along lines now being developed by some of the foremost fuel technologists.

## Technical Consultation Service

QUESTION 88: FORMULA FOR ACID ETCHING TRANSFER INK. Kindly give us a formula for acid etching transfer ink and the method of applying same; also methods of preparation of special tissue paper used in this line of work, and directions as to how a good etching bath may be obtained.

ANSWER: The tissue paper should be strong and yet thin. It should be dipped in the following solution:

4 liters of distilled water
100 grams of common salt
150 grams of pulverized alum

The paper is allowed to drain and is suspended until fully dry.

Make up a solution of 250 grams of glue into one liter of distilled water. First allow it to stand 48 hours. Bring to a boil. When the glue is dissolved add:

100 grams of glycerine
25 grams of common salt

Add a little aniline blue, dissolved in water. Filter the solution through a fine cloth (Solution B).

Take a piece of the paper and paint with some of Solution B. Allow to dry and if the covering is too brittle, add a little more glycerine to Solution B.

The paper is now covered with a thin, even layer of Solution B by means of a brush, and allowed to dry. A second coat is applied and the paper is rolled between two rollers.

The design is then printed on the paper. One of the following formulas is used:

| | I | II | III | |
|---|---|---|---|---|
| Oil of turpentine | 480 | 460 | 400 | parts |
| Pulverized Syrian asphalt | 180 | 200 | 160 | " |
| Yellow beeswax | 125 | 150 | 130 | " |
| Rosin | 100 | 100 | 100 | " |
| Printers' varnish | 50 | 50 | 40 | " |
| Tallow | 10 | 10 | 10 | " |

After printing the design on the paper it is allowed to dry. The paper is then placed on the glass, the back is moistened and the paper pulled off carefully. The design is then dusted with powdered asphalt which is removed with a soft brush wherever the glass is to be exposed to the etching bath.

Another method to prepare the paper is as follows:

A. To 1 liter distilled water add 200 grams of starch and mix. To the milk-like liquid add a little aniline blue.

B. Bring 1 liter of distilled water to a boil and add:

25 grams of common salt
70 " " glycerine
50 " " glue, softened in water
25 " " molasses (sugar)

When everything is dissolved, pour Solution A into B and boil a little longer. Allow to cool with frequent stirring.

The paper is covered on one side with a thin, even layer of this solution After drying, it is pressed between rollers and is then ready for printing.

The following etching bath gives a fine matt:

| | | |
|---|---|---|
| Solution I | 5 | parts of pulverized potassium fluoride |
| | 4 | " " potassium sulphate—pulverized |
| | 20 | " " distilled water |
| | 3½ | " " hydrochloric acid |
| Solution II | 50 | parts of ammonium fluoride |
| | 5 | " " ammonium sulphate |
| | 50 | " " distilled water |
| | 10 | " " sulphuric acid |

For different purposes Solutions I and II may be mixed in various proportions. For an ordinary matt, mix 2 parts of I with 1 part of II. For a dense matt mix equal quantities of I and II.

If the bath becomes exhausted some more ammonium fluoride should be added, namely, from 5 to 10 parts for every 50 parts used originally.

---

GAS ENGINEERS are watching with considerable interest the experiment of a small gas company in Sheridan, Wyoming, which is using local lignite deposits for making coal gas.

# International Capital in the German Glass Industry*

## American and Belgian Co-operation in Europe

### By Dr. Fritz Haubold†

The process of mechanizing of the glass industry had its origin in the United States of America. It was there that the tiresome hand labor was first given up for working methods by tools and machinery founded on inventions of a radical kind. For window glass this was the case by means of Lubber's inventions. The fact that the patents aiming at the further development of these means of production were developed by American and Belgian capital, and Belgian plants used for their realization, has its simple cause the leading position which the Belgian glass industry held on the world market since the end of the 19th century, after it had failed to hold its place against Bohemian, English, German, French and Italian labor. Again the technical connection between coal and sheet glass explains the by no means accidental seat of this industry: The Ruhr, the Saar, Upper-Silesia and the country around Charleroi in Belgium. It may be of interest that the plants founded in 1740 in Letterbach (St. Quirinus) situated south of Saarbourg on the boundary of Alsace and Lorraine are considered to be the seat from which originated the modern French and Belgian sheet glass works. These plants were erected for the manufacture of glass in cylinders and employed German labor. Nowadays American and Belgian influence begins also to take direct interest in Germany.

### The International Company for Mechanical Production of Glass Aims at Extension

The *Compagnie Internationale pour la fabrication mécanique du verre* in Brussels has already established in all important countries of western and southern Europe formally independent affiliated companies for the exploitation of the Libbey-Owens patents, the importance of which will be commented upon by us later. Such works have been erected or are being built besides in Belgium and France (in this country even two), in Spain, Italy and Switzerland. As already mentioned the company has now made the first move to obtain a hold also in Central Europe. The first factory planned in Germany is the "DELOG" (*Deutsche Libbey-Owens-Gesellschaft für mechanische Glasherstellung A.-G., Gelsenkirchen-Rotthausen*). As far as the actual intentions are known this establishment is to remain the only affiliated company in Germany. Founded on the above-mentioned American patents these companies produce certain sorts of sheet glass which are used essentially as window glass. It is in this line that the new establishment carries its paramount importance as a competition for the German sheet glass industry. (In which German works these machines are already employed or are to be in future will be explained later.) This does not interfere with the bottle industry of which we have one of the most important establishments in Western Germany in the Gerresheimer Glass Works formerly Ferd. Heye, in Düsseldorf. These secured the Owens patents for Europe for the production of bottles. Heye also produces in the line of sheet glass, rolled, wired and figured glass, though the manufacture of bottles is by far of primary importance for the Heye works.

The DELOG has not yet been legally incorporated in the Gelsenkirchen register, and therefore as a matter of fact is still in a state of preparation. As is the case in Dahlbusch it must be considered, that, if in capital and Board of Supervision, Belgian influence is predominant and therefore the revenues go to a large extent abroad, on the other side these works will give work to German labor and bread to German families. It will perhaps be here that the DELOG is going to centralize its production and sale for Central and perhaps later for Eastern Europe. It is projected that the Rotthausen-Gelsenkirchen plant

*Rheinisch-Westfälische Zeitung.
†Editor, Essen-Ruhr, Germany.

of the DELOG shall be finished at the end of 1926, and Dahlbusch is looking for a building manager for the construction of this big new plant. When all machines for manufacturing glass, the installation of which is planned in Germany, especially in Western Germany, will be in full production, the present full occupation of the works will give way to an overproduction.

### Libbey-Owens and Fourcault Device

The Libbey-Owens device comprises the manufacture of drawn sheet glass which, as is known, was formerly blown. These machines are constructed to draw the glass out of the tank in an endless band which after having been annealed, is cut to desired sizes. In Germany window glass until now was produced by Fourcault's device on the base of which at least one new German factory is being built. The opinion of technical authorities diverge in regard to the advantages and disadvantages of the Libbey-Owens and Fourcault system. German technical circles to a large extent attribute superiority to the latter system. Independent of this, sharp competition in times of business depression will necessarily sooner or later have to lead to some understanding on a base of repartition and limitation. Experience has shown that in fights for existence of this kind, the one or the other is knocked down.

The Americans have erected plants in Belgium on a very large scale and their outward appearance insistently presents the impression that they are not quite appropriate to the European particularities which are so very different from those in America. If as yet the German sheet glass industry by no means stands in a helpless and hopeless attitude towards the new competition, still it must be considered most detrimental for the German economical system that in the present times of retrograde economical development and of a relative standstill in the glass industry the fight for a market should be rendered more severe by means of foreign capital. As the working plants have to be built from the foundation up, production will probably begin in one or two years and by then the situation on the market may have considerably changed. It must be remembered that this entirely depends upon the conditions in the building trade which, as far as the Ruhr district is concerned, at present absolutely stagnates. Therefore competent opinion to some extent is skeptical.

### Gas Derived Directly from the Coal Mine (Mathias Stinnes and Dahlbusch)

The new American glass machines are being employed among other places in Saabrücken (Richardhütte) and their use is planned for the Glass Works of Gebr. Müllensiefen in Crengeldanz near Witten. A combine is further erecting an adequate plant at Torgau on the Elbe. Also the well known establishment of Stinnes (the Glass Works Ruhr A.-G. Essen) is entirely built for mechanical production. The Glass Works Ruhr derive their gas in exactly the same way from the coal mine Mathias Stinnes in Carnap, as in future the DELOG will do from Dahlbusch. The difficulties this industry has to go through in the beginning are very considerable and like every new establishment the Glass Works Ruhr took a very long time before their production was quite normal; probably this will not be different with the plant projected by the DELOG. The principal articles produced at Stinnes' glass works are containers of very clear glass, as fruit jars, medicine bottles, milk bottles, etc., and glass tubes of all kind. To a certain extent the production is the same as in Ilmenau and other places in Thuringia with which Stinnes had formerly intended a much closer connection than that which presents itself today. In a very clever way nevertheless a certain relationship has been formed between a very highly developed mechanical mass production (of tubes) and Thuringian home hand labor (progressive elaboration of these tubes to ornamental glassware for the Christmas tree, barometer, thermometer and other kind of tubes). By means of six Danner machines tubes are manufactured at the Ruhr Glass Works, but as mentioned before the production mainly consists of glass containers and pressed glass, the machinery for these articles being licensed by the patents of Tucker, Reeves and Beatty. The daily production exceeds 100 tons. The American patents were, however, not acquired by the Stinnes Glass Works under exclusion of other licenses in Germany. At any rate it has become public that a different group is considering the protection of certain claims it has on account of patent agreements by taking recourse to legal proceedings. With the Jena glass works of Schott and Genossen which, as also the Osram Company in Berlin does, are producing by means of the above mentioned machines, the Stinnes company in Carnap has been able to come to an understanding. The sale of the products is effectuated by both works mutually. The American patents are also in use in Scandinavia. In connection with the liquidation of the Stinnes firm, negotiations for sale are said to be going on between the bankers combine, Heye and Osram.

### The Situation of the Sheet Glass and Bottle Industry

As regards the situation of the German bottle industry, business in this branch is always very much dependent on weather conditions during the summer. In 1925 conditions in this regard were normal. Notwithstanding, as we hear, in one of the leading factories in this branch production is restricted by 30 per cent. The difference of opinion regarding the present situation in the window glass industry has its origin in the fact that activities in the industrial centre of German building have been entirely stopped owing to the critical situation caused by the fact that all industries—and especially the iron and coal industry—are suffering strongly from lack of liquid funds; accordingly demand for window glass in general was therefore restricted. In the unoccupied part of Germany demand is still comparatively satisfactory, to some extent works are even well occupied, at least a number stipulate extensive terms of delivery for orders. Demand for plate glass is considered weaker everywhere except for sales to the United States of America where by reducing prices the German plate glass industry seems to have been successful against Belgian and Czechoslovakian competition.

### The Importance of the Belgian Glass Industry

Before the war Belgian glass industry already comprised 76 plants belonging to 69 firms; 34 of these were crystal glass works for production of goblets and flagons in which article Belgium is still dominating as was proved at the yearly show of the Netherlands in Utrecht last autumn. Twenty-four plants belong to window glass works for blown and drawn glass, and 10 for plate and special glass works. In comparison to this bottle works (3) and factories of molded and pressed glass, likewise for blown and drawn glass cylinders and tubes are only of minor importance. Regarding the geographical distribution of these industries the province of Hainaut is by far preponderant. It is well known that in Belgium the glass works Val Saint Lambert has a leading position. These works employed ten years ago 5,000 workmen for the production of all sorts of crystal glassware of world-wide fame. They will this year have been in existence exactly 100 years. Unfortunately the importance of the Belgian glass industry has brought the German production into strong financial, technical and personal dependence.

### German Glass Industry Depends on International Restrictions

One of the few German glass works which was able to preserve its independence from Belgian capital and American influence, at least to outward appearance, are the glass and plate glass works in Schalke (450 workmen); their general manager Mr. Grozbüning regularly attends the meetings of the International Plate Glass Syndicate (*Convention Internationale de Glaceries*), at Brussels. Nearly all other glass works of Germany are financed by Belgian or French capital. This explains a fact which at first sight appears curious, that the said combine even during the war did not cease to place its orders with German works. Entirely in hands of combines are the shares of the Plate Glass Works Reisholz A.-G., after the Gerresheim Glass Works had given them up. The International Plate Glass Convention has the majority. Before the war the French interest in the syndicate was 49.1%, the Belgian 12.3%. In the beginning of 1915 the said Plate Glass Works Reisholz became member of the syndicate and thereby the participation in the turnover for the French members came to 31%, for the Belgian members 12% and for the German members 56.7%. The preponderance of German influence expressed itself also by the participation in the capital of the German association.

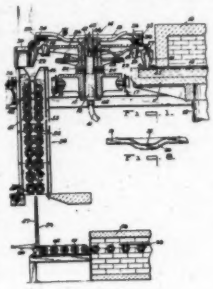
Foreign capital forms also the base of the French glass works in Stolberg (not to be confounded with Siegwart). To these works belong also the Glass Works Waldhof near Mannheim and Altwasser (Silesia). This firm further participates in the glass works in Herzogenrath near Aix-la-Chapelle, in the Glass Works Reisholz near Düsseldorf and in the German Plate Glass Works in Freden.

# Recent Patents

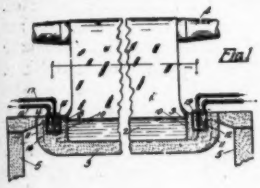
**NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT**

**Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each**

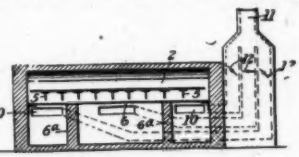
SHEET-GLASS APPARATUS. U. S. 1,569,465. Jan. 12, 1926. John L. Drake, Toledo, O., assignor to the Libbey-Owens Sheet Glass Co. Filed 4/30/25. Sufficient vacuum or suction is created within the mold to draw up a charge of glass. The charge is retained in the mold until it is above the troughed end 46 of the sheet-forming mechanism 28, where the roller 34 will ride out upon the cammed track section 35, opening the mold and permitting the gob 28 to be discharged therefrom. The gob is permitted to run between the sets of rolls 47. The rolls 47 are arranged relatively far apart at the end 48 and relatively close together at the end 49. The rolls 49 determine the thickness of sheet formed.



SHEET-GLASS-DRAWING APPARATUS. U. S. 1,569,471. Jan. 12, 1926. Arthur E. Fowle, Toledo, O., assignor to the Libbey-Owens Sheet Glass Co. Filed 12/18/20. An apparatus for producing sheet glass, wherein a sheet is drawn upward from a mass of molten glass, a pot containing the bath of molten glass, said pot having projections extending inwardly from the side walls adjacent the sources of the sheet edges, and cooling means within the pot walls and out of contact with the molten glass for maintaining the projections at a lower temperature than the other portions of he pot.

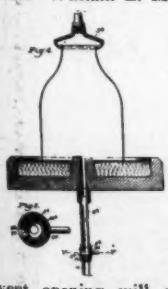


METHOD AND APPARATUS FOR ANNEALING AND COOLING SHEET GLASS. U. S. 1,570,822. Jan. 26, 1926. Frederic L. Bishop, Pittsburgh, Pa., assignor to Window Glass Machine Co. Filed 9/4/24. In a lehr tunnel of ordinary construction, the gas stream above the glass soon becomes much hotter than the stream below, and as a result the lower face cools more rapidly, so that the glass is warped when it is delivered from the lehr tunnel.

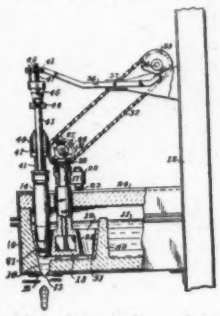


The lehr shown in the Hartzell (Serial No. 693,249) application is effective for overcoming in a large measure the defects present in the ordinary lehr. The inventor has found that it is desirable to effect a further regulation by providing means for transverse control of the temperature from side to side of the lehr tunnel. This control may be accomplished, for example, by dividing the space under the tunnel into a plurality of chambers and separately regulating the heating of the various chambers or by the provision of dampers.

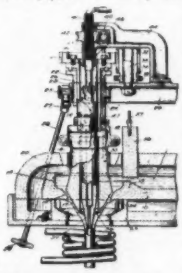
MANUFACTURE OF GLASS CYLINDERS. U. S. 1,570,853. Jan. 26, 1926. William L. Monro, of Pittsburgh, Henry F. Clark, of Oakmont, and Lonnie J. Pierce, of Pittsburgh, Pa., assignors to Window Glass Machine Company. Filed 5/29/18. Designed to improve the Lubbers venting system used in the drawing of glass cylinders, and still further reduce or eliminate the pulsations of the air within the cylinder. The novel feature of this structure lies in the fact that the jet opening into the air chamber is of smaller bore than the chamber from which the vent opening leads, the latter being larger than this inlet jet opening. This new relation of the size of the inlet air opening to the vent opening will greatly improve the cylinder as regards the presence of pulsation bumps.



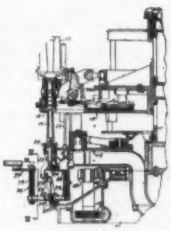
GLASS FEEDER. U. S. 1,571,215. Feb. 2, 1926. Leonard D. Soubier, Toledo, O., assignor to the Owens Bottle Co. Filed 8/27/23. Relates to apparatus for feeding charges of molten glass and particularly to a glass feeder of the type in which the discharge is regulated and controlled by means of a periodically reciprocated regulating plug projecting into the glass above the outlet. Mounted on a vertically disposed shaft and projecting downward into the glass, is a glass-covering member constructed of refractory material and having formed therein a series of pockets. The walls of these pockets are tapered so as to form with the well and the front wall of the boot, a funnel shaped discharge chamber, when one of said pockets is in register with said well.



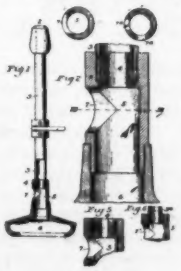
METHOD OF AND APPARATUS FOR FORMING GLASS TUBING. U. S. 1,571,216. Feb. 2, 1926. Leonard D. Soubier, Toledo, O., assignor to the Owens Bottle Co. Filed 10/4/23. In a tube forming device, the combination of a container for molten glass having an outlet opening in the bottom thereof, a forming device projecting vertically downward into the glass and through said opening, a blow pipe within and projecting below the said forming device and providing a surface over which the glass flows beyond the forming device, and means to adjust said blow pipe vertically relative to the forming device and thereby vary the size of tubing. Means are also provided for circulating the glass at the outlet so that the issuing glass will be of uniform viscosity.



MACHINE FOR FORMING GLASS ARTICLES. U. S. 1,571,445. Feb. 2, 1926. Albert N. Cramer, of Toledo, O., assignor to the Owens Bottle Company. Filed 7/21/23. An object of the invention is to overcome the variation in the extent to which the depending parison is thrown out of vertical alignment, and also in the position reached by the parison in its travel with the mold carriage by the time the parison has swung to its vertical position, by providing suitable adjusting means for controlling and adjusting the movements of the mold bottom so that the parison will be properly centered thereon.

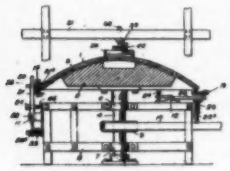


GLASS-DRAWING APPARATUS. U. S. 1,570,695. Jan. 26, 1926. William L. Munro, Pittsburgh, Pa., assignor to Window Glass Machine Co. Filed 11/6/22. Pulsations of the air in the cylinder of glass being drawn are reduced or avoided if the venting chamber is moved to a position adjacent the bait. The invention has a bait, a chamber adjacent the bait, and a nozzle of smaller cross sectional area than the chamber adapted for the discharge of air in jet form through the chamber and into the bait, the chamber having a substantially continuous wall at one side of the path of said air jet and having an opening opposite such wall.

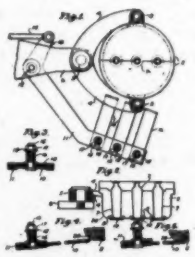


APPARATUS FOR CRACKING OFF AND HANDLING CONTINUOUSLY FORMED SHEET GLASS. U. S. 1,569,079. Jan. 12, 1926. Albert E. Evans, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co.

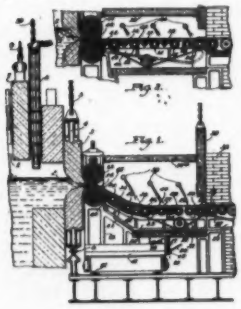
APPARATUS FOR FINISHING REFLECTOR BLANKS. U. S. 1,572,451. Feb. 9, 1926. William H. Taylor, of Ford City, Pa., assignor to Pittsburgh Plate Glass Co. Filed 6/5/22. Apparatus for finishing the edges of glass reflector blanks and particularly the large sizes employed running up to 60 inches or more in diameter. A table or support, means for securing the blank to be finished to such table or support, idler grinding devices arranged around the periphery of the table or support, means causing such devices to press against the edge of the blank, an annular cutter with its axis concentric with the axis of the table or support engaging the surface of the glass, and means for causing the table and grinding devices and cutter to rotate relatively to secure a cutting action between said grinding devices and annular cutter, and the glass blank.



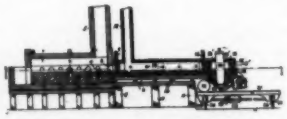
MULTIPLE-MOLD SHEAR DEVICE FOR GLASS-WORKING MACHINES. U. S. 1,572,143. Feb. 9, 1926. George E. Howard, of Butler, Pa., assignor to Hartford-Empire Company. Filed 3/21/25. A multiple-mold shear device for glass-working machines, especially those of the Owens type, comprising an oscillable blade support having a depending flange at one side, a plurality of blades, each of which is secured yieldingly beneath the said support with the rear end of the blade engaging the said depending flange, bolts extending through registering openings in the said blade and in the said support, a spring surrounding each of said bolts above said support, and nuts for adjusting the compression of said springs.



APPARATUS FOR MAKING SHEET GLASS. U. S. 1,572,468. Feb. 9, 1926. Robert L. Clause, Sewickley, Pa., assignor to Pittsburgh Plate Glass Co. Filed 5/13/25. Apparatus for forming sheet glass continuously in a sheet or ribbon from a body of molten glass, comprising a pair of cooled rolls contacting with said molten body of glass, and a table for receiving the glass and forwarding it, comprising a series of spaced rollers, a series of platens interspersed between the rollers having their upper surfaces substantially flat and filling the spaces between the rollers, and means for cooling the rollers and platens.



METHOD AND APPARATUS FOR CASTING PLATE GLASS. U. S. 1,572,580. Feb. 9, 1926. Frank E. Troutman and Charles H. Christie, Butler, Pa. Filed 12/28/21. This casting system as set forth and claimed in copending applications for Letters Patent filed May 7, 1919, Serial No. 295,485 and Serial No. 295,486, now issued as Patents No. 1,535,061 and No. 1,535,062, respectively, involves the use of long extension or forehearth from the tank furnace, through which glass flows from said tank furnace, the purpose being to reduce the temperature of the glass from the furnace temperature to a suitable working temperature. This forehearth terminates in a discharging well controlled by a plug or plunger which operates to close the discharge opening in the bottom of the well and also serves to give an impulse to the discharging glass. The glass issues from the well in a thick, cylindrical column, and is received upon a casting table which is passed beneath the opening so as to receive the column of glass in a long mass of approximately uniform thickness, ready to be rolled out into a sheet by means of the usual roller.



CASTING PLATE GLASS. U. S. 1,572,581. Feb. 9, 1926. Frank E. Troutman and Charles H. Christie, Butler, Pa. Filed 4/14/24. A system of casting plate glass wherein the molten glass is discharged in a vertical column through an outlet and is received on a casting table which is moved beneath the outlet to receive a charge of glass, the glass being then rolled flat upon the table in the usual manner. When it is desired to re-establish the flow of glass, after temporary interruption it is difficult to re-establish it because the glass at the outlet tends to chill and clog the outlet.

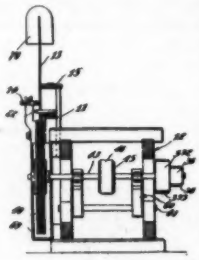
GLASS AND ARTICLE MADE THEREFROM. U. S. 1,570,876. Jan. 26, 1926. Arthur H. Compton, St. Louis, Mo., Assignor to Westinghouse Lamp Co. Filed 10/16/20. An improved method of making a glass characterized particularly by the property of being resistant to heat and to the chemical action of the alkali metals or their vapors such as those occurring in vapor electric lamps.

In the preparation of such glass the following oxides may be used, preferably in the indicated proportions, by weight:

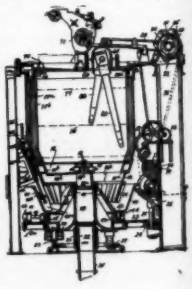
| | Per Cent |
|---|---|
| Sodium oxide | about 13 |
| Aluminum oxide | about 15 |
| Calcium oxide | about 12 |
| Boron oxide | about 60 |
| Total | 100 |

Other oxides may be used, in addition to, or in the place of, some of the oxides mentioned in the above formula, which are capable of forming a glass equally as good. These are the oxides of lithium, potassium, magnesium, barium, strontium, rubidium, thorium, zirconium, etc.

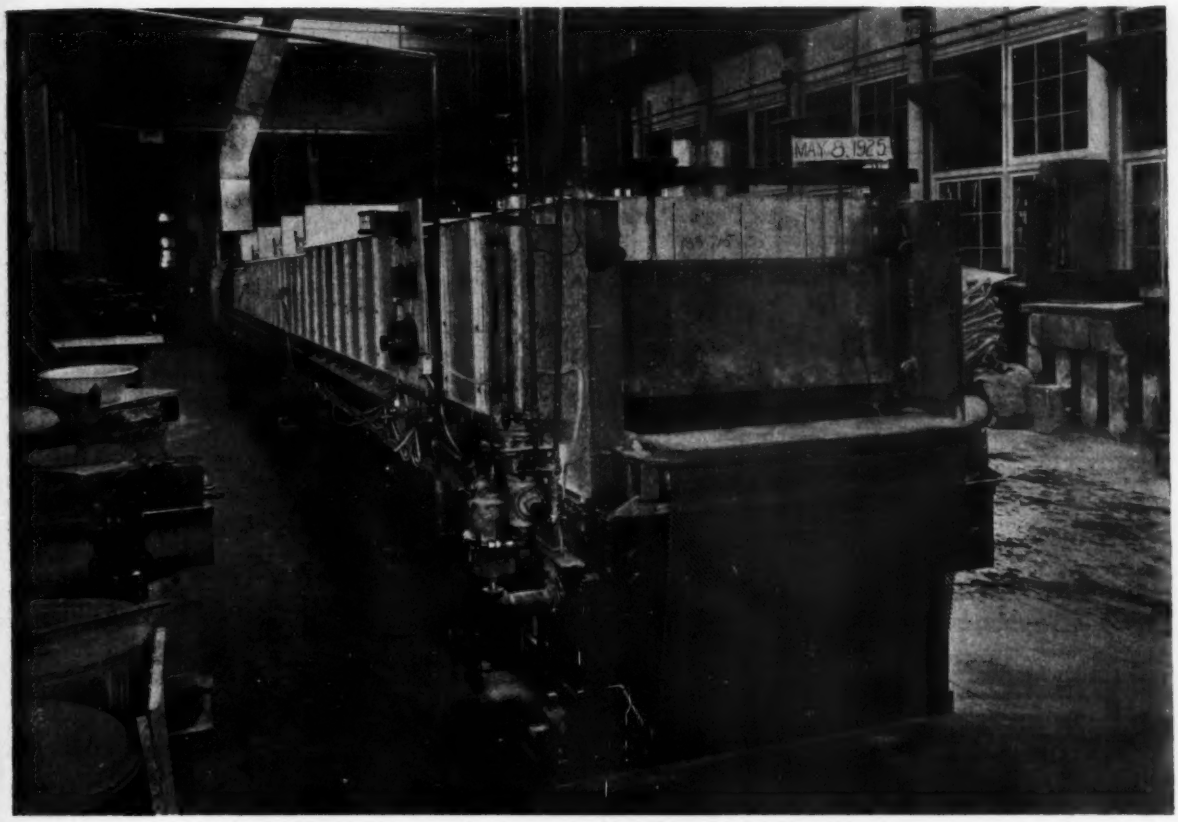
MACHINE FOR GRINDING GLASS PLATES. U. S. 1,571,985. Feb. 9, 1926. Karl A. Weber, Los Angeles, Cal. Filed 3/18/24. A machine for grinding the edge of a glass plate or a plurality of plates comprising a line of support upon which a glass may be stood on edge in a substantially vertical position, means for guidingly maintaining it in such a position, and grinding means having a groove, shaped to grind the edge of the plate and surfaces adjacent said edge to finish and shape the same as predetermined, said grinding means moving in the line of feed of the glass and located substantially on a level with said line of support and onto which the glass moves and by which it is supported on edge while being ground.



GAS PRODUCER. U. S. 1,572,040. Feb. 9, 1926. John F. Rogers, Cleveland, O., assignor to the Wellman-Seaver-Morgan Co. Filed 12/26/18. In a gas producer, the combination of a rotatable producer body below a non-rotating top, having at its lower end a tapered ash hopper, means to rotate said producer body, a coaxial ash pan located below the producer body in such position that the lower part of the ash hopper projects into it, a mechanism which as the producer body and ash pan are turning will act automatically at predetermined intervals and compel the ash pan to turn a short distance at a different rate from that at which the producer body is turned. Also, an inclined plow which projects into the ash pan between the outer wall thereof and the ash hopper.



DECORATING GLASS SURFACES. U. S. 1,570,368. Charles C. Zeh, North Hackensack, N. J., assignor to Zeh Incorporated. Filed 11/3/26. The process consists in placing a decalcomania of the design on the front side of a sheet of opal glass, causing the rear side of the opal glass to adhere temporarily to the transparent glass object and subjecting the two glasses to a heat treatment to cause the opal glass to adhere by fusion to the glass object.




# The Hartford-Empire Lehr

## A Remarkable Advance in Annealing as Described for the British Trade by Clement Saxton*

The necessity for proper annealing is not confined exclusively to the manufacture of glassware, as the operation is required in connection with many other industries, such as in metal working, where, during drawing, rolling and hammering the article or material operated upon is annealed frequently during the process. While, however, there may be a similarity between the methods employed in such cases and those used in annealing glassware, the reasons for doing so are not exactly the same.

Until a comparatively few years ago, the most important desiderata in annealing glassware was considered to be "slow" cooling, based on the theory that "the longer the cooling period the better the annealing," and it is still possible to find some of the old "bottle arches" in use where the bottles are allowed to cool over a period of about three days. With the advent of more improved methods of manufacture the "arches" were found to require too much space owing to this time factor, and they generally gave place to the tunnel or "continuous" type lehr, in which one end is always maintained hot by means of burning coal, coke, gas or oil (latterly electricity has been successfully employed) and the other cold; various ways and means being adopted to move the bottles or glassware progressively from the hot to the cold end.

In addition to reducing considerably the time occupied in the process (down to 7-8 hours) it was found that the adoption of these tunnel lehrs also resulted in a material saving in the fuel consumed, owing to the fact that a mass of brickwork, etc., was not being alternately heated and cooled as was the case with the "bottle arches."

It was only to be expected that these early lehrs were rapidly improved although these improvements were chiefly, if not solely, connected with the mechanical construction of the equipment (especially with the chain and slats, etc., forming the continuous conveyor for carrying the glassware) making them more efficient from the point of view of fuel consumption and quality of annealing, as well as less liable to breakdown, but otherwise the principles employed remained the same.

With all the systems, however, there was always a certain loss of ware due to defective annealing, and prior to the war this would appear to have been considered a manufacturing risk and unavoidable. In addition, owing to the fact that the products of combustion passed down the same chamber as the ware, the latter invariably arrived at the cold end covered with a "bloom" which had to be removed by washing before the bottles could be used.

In an endeavor to obtain a better distribution of heat throughout the hot section of the tunnel, different makers adopted the "muffle" principle in which the heat was applied to the outside and all round —i. e., top, bottom and sides—the hot end of the tunnel, and this went a long way towards achieving the desired results, as not only was a better and more regular distribution of heat obtained, thus reducing the loss or breakage in the lehr and giving better annealing, but the "bloom" was avoided as the gases never came in contact with the ware. Also the time required to pass the bottles through the lehr was reduced to an average of about 4-5 hours.

During the period that these improvements were being introduced, numerous workers were engaged in researches into the chemical and physical questions connected with annealing, and it was soon evident from the results obtained that existing theories upon the subject would have to be modified considerably. Further research showed that for each and every glass there exists what are termed upper and lower annealing temperatures, also that instead of a uniform rate of cooling being advisable, the rate should vary at different stages during the cooling process, and it was shown that the time required to anneal bottles could be again materially reduced, under ideal conditions the time required being less than 20 minutes.

As the ware leaves the finishing molds of a forming machine there is usually a difference in temperature between various parts

*Consulting Engineer and editor of *Glass*, Talbot House, Arundel street, Strand, London.

of any individual article, the outside naturally being the coolest portion. Nevertheless, in spite of this fact, with modern rates of production, the total heat contained by the ware as it leaves the mold, if distributed equally throughout it, will usually be sufficient to raise every part to a temperature sufficiently high to release any existing stress, so that if the disposition of the lehr is such that advantage may be taken of this fact it will be obvious that a considerable economy in fuel will result.

Numerous and costly experiments were carried out in an endeavor to arrive at a lehr design which would enable glass manufacturers to obtain the maximum practical value from this research work, and we have pleasure in describing the latest developments in this direction which are embodied in The Hartford lehr.

One of the outstanding features that will be noticed from the illustrations is the absence of brickwork, both ordinary and refractory, the whole of the construction (with the exception of the fire-box lining) being metallic. The annealing chamber proper through which the bottles pass, consists of a series of short cast iron sections securely fastened together in such a manner that the chamber is hermetically tight—top, bottom and sides—throughout its entire length. The bottom of the chamber is hollow the whole length of the closed part of the lehr while the top is hollow for a considerable portion of the distance from the cold end towards the hot.

The hollow top and bottom each form a long continuous tunnel, so that the lehr may be considered as consisting of three continuous and entirely distinct chambers arranged one over the other, the glass ware passing through the middle one. Both top and bottom flues or ducts are connected to the inlet of an induced draft fan, dampers being provided in order that the draft or "pull" in each case may be under complete and independent control.

Owing to previous experiments in this direction in which an attempt was made to avoid completely the use of additional heat, one often hears these lehrs referred to as "fireless," but it should be made clear at once that the consumption of a certain amount of fuel is a necessity to the principles of operation of the one we are describing, although the amount of fuel so required is reduced to comparatively small percentage of that usually consumed in existing types.

This fuel is burned in a small combustion chamber placed underneath the front or hot end of the lehr, and the only outlet for the hot gases is by passing into and through the lower tunnel forming the bottom of the annealing chamber, the necessary draft or "pull" being provided by means of the induced draft fan.

At various points throughout its length cold air may be admitted to this hot gas tunnel or flue, the amount so admitted being capable of accurate control by means of a very simple yet highly effective species of valve at each point. It will thus be obvious that, as the amount of air entering at each point can be regulated from nothing to the maximum independently of the others, the dilution of the hot gases with cold air and consequently the temperature of the tunnel may be made to conform to any desired or predetermined cooling curve, especially as the draft intensity or pull can also be controlled independently of that due to temperature of the gases, by means of dampers placed in the connecting trunks between the lower tunnel and the exhaust fan inlet.

Due to conduction, convection and radiation the top portion of the annealing chamber becomes heated, and the means adopted to control the temperature in this portion involve a reversal of the method used with the bottom section. A secondary or auxiliary suction pipe is run along the top of the lehr from the inlet of the fan, the far end of the pipe being closed. Downcomers provided with regulating dampers connect this auxiliary suction pipe with the top tunnel or duct at various points. This tunnel is open to the atmosphere at the cold end of the lehr only, so that if one of the dampers in the downcomers just mentioned be opened, cold air is drawn into and along the tunnel until it reaches the downcomer in question, it then passes upwards into the auxiliary suction pipe and back to the fan.

A little consideration will show, therefore, that in this way exactly the same facilities for control are obtained for the top as for the bottom, it simply being a question of adjusting the dampers to cause the cold air to travel a greater or less distance before it passes into the auxiliary main and to regulate the positions (and quantities) at which it is withdrawn en route, and in this manner it is possible to regulate the temperature at the top of the lehr without affecting that existing at the bottom.

It should be realized, however, that the positions, spacing and sizes of these various connections in the upper and lower flues have been calculated to give the desired results and are not simply haphazard dimensions.

One of the advantages of this method of temperature control is that, as the pressure in both top and bottom flues or ducts is less than atmospheric or that existing in the middle tunnel through which the ware passes, it is impossible for there to be a leakage of cold air or hot gases into the center tunnel, causing local cool or hot spots which seriously interfere with the successful annealing of the ware.

In the construction of the lehr full advantage is taken of the benefits to be obtained from the correct use of heat insulation, and here again the quantities used at the different positions are the results of study and experiment.

In the illustrations a number of small rollers will be noticed down the side of the lehr. These are attached to the lehr proper and are the only connection between it and the supporting structure, except at the hot end. In this way expansion of the various parts is allowed for, as the whole of the lehr is free to move longitudinally with reference to the supports without in any way straining joints or otherwise affecting the successful operation of the whole. This feature of the construction is one which many works managers will appreciate as obviating the difficulties due to warping of angles, runners, etc., with the consequent trouble with chains, etc.

The belt or conveyor portion of the lehr is extremely interesting as it presents a complete departure from existing practice. Instead of the usual pressed steel slats—to form the carrying surface—attached to two or more chains to take the strain and carry the weight, the belt in question is composed of interlaced spirals made of steel wire. It is found that this arrangement works extremely well and possesses numerous desirable features. It is very flexible, does not warp due to heat, while no additional chains are required.

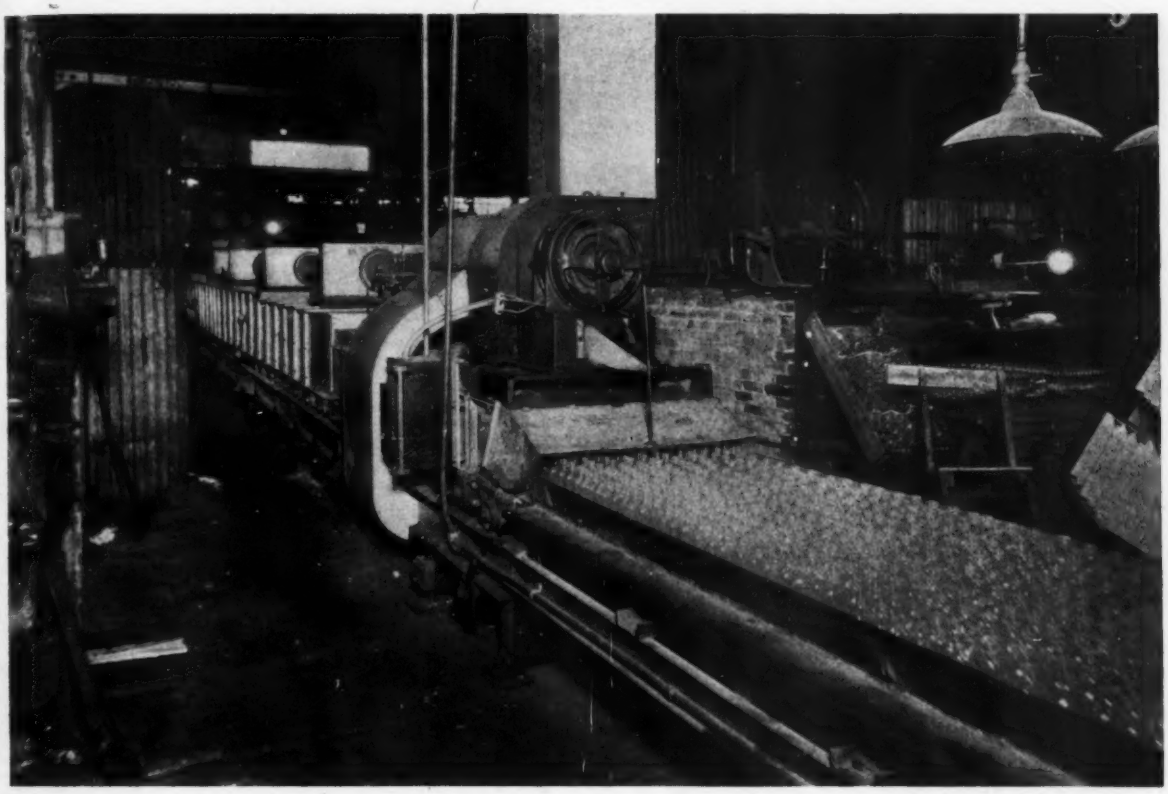
Furthermore, it possesses a very low "heat mass," and consequently not only does it quickly attain the temperature of the hot end of the lehr on entering but does so without requiring the expenditure of considerable fuel. In addition, owing to its open construction, it does not act as a mask to the bottom of the lehr but allows the heat radiated from it to have direct access to the bottoms of the ware, and as the ware is supported by the summits of a few spirals, practically point contact is obtained. The advantage of this may be judged from the fact that no case has yet been found of a bottle with strain in the bottom, the usual position with some of the older systems.

The load on the belt is not sufficient to cause serious rubbing on the bottom of the annealing chamber. This bottom is machined all over so that friction is reduced to a minimum. This will be realized when it is stated that the driving motor installed is only ½ H. P., and even this gives a margin of 50%.

As will be seen from the illustrations the driving mechanism is self-contained, being placed inside the framing. The necessary tractive effort is applied to the belt by passing the latter between and around two rollers covered with a rubber compound, while facilities are provided for taking up any extension of the belt due to expansion or wear.

Another interesting feature in connection with the lehr is that the tunnel is erected in such a manner that there is a slight fall from the hot to the cold end. The object of this is not to reduce the power required to move the ware through the lehr, as some people appear to think, but to cause a tendency for air to flow through the centre tunnel from the cold end and therefore in the opposite direction to the movement of the ware. This flow of air, if such it may be termed, is barely sufficient to prevent the entry of cold air at the hot end of the tunnel and does not exercise any material cooling effect upon the glass.

It will be realized that it is essential to have correct knowledge of the temperature conditions at the various points in the lehr and consequently 10 thermocouples are provided, with the necessary switch enabling any couple to be connected to the indicator. Eight of the couples are inserted in grooves in the bottom and top of the annealing chamber, those in the bottom being immediately underneath and almost in contact with the belt so that the temperatures indicated are really those existing *in* the annealing chamber at the different points. As the draft is independent of atmospheric conditions, draft gauges are provided to enable the dampers



DISCHARGING END OF THE HARTFORD-EMPIRE LEHR

to be set correctly and also to enable any desired set of conditions to be reproduced at any future time, if so desired.

As manufactured at present—to take the maximum output of one forming machine of the Lynch, O'Neill or similar type—the annealing chamber has a section of 34" wide and 15" high, the closed portion of the lehr being approximately 60 feet long, but the open portion can be made any length to suit individual cases; in fact, it can be made to serve as a conveyor to deliver the bottles into the packing room owing to the lightness of the belt and consequent light structure required to support it. The overall width of the lehr outside *everything*, except the two side suction ducts, is 4' 0" while the overall height to the top of the fan is less than 7' 0". It will thus be seen that very little floor space is required, and owing to it being self-contained no foundations are required as it can be placed direct on the floor.

It may now be of interest to give some of the results obtained. As regards fuel consumption actual tests in which one of these lehrs was installed and operated alongside one of the best known makes of muffle lehrs, 10' 0" wide, each lehr taking the same size and type of bottle from machines at the same tank, the respective consumptions were:

Hartford ..... 3,000 cu. ft. gas per 24 hrs.
10' 0" muffle..... 35,000 " " " " " "

The muffle lehr annealed twice the weight going through the Hartford as it was fed by two machines, so that for equal weights annealed the ratio was as 1 is to 5.8 or approximately 1/6.

Against this must be set off the cost of running the induced draft fan which absorbs about 4 k.w. or 4 units per hour, but there is a saving on the power required to operate the belt, this saving reducing the extra power required to about 3 units per hour.

From the point of view of efficiency of annealing, the report of one of the largest firms of bottle manufacturers in America, after installing one and then ordering a further 15 lehrs of this type is, that they immediately got an increase of 5% in the output of salable bottles, due solely to improved annealing.

The actual time required to pass the bottles through the lehr has been reduced very considerably, and we may mention the following:

| Type of Ware | Weight in Ounces | Size or Capacity | Pieces per Minute | Time Going Through 60 Feet Lehr Tunnel |
|---|---|---|---|---|
| Lantern globe | 10½ | ..... | 19 | 43 minutes |
| Tablet jar | 28½ | 5" square | 10 | 76 " |
| Wine Tray | 36 | 11" dia. | 2.6 | 76 " |
| Mustard | 8½ | 8 ozs. | 18 | 95 " |
| Milk bottle | 26 | quart | 14.5 | 95 " |
| Beer | 28 | quart | 13 | 120 " |
| Flask | 8¼ | ..... | 15.5 | 150 " |
| Minerals | 14 | 6 ozs. | 14.5 | 150 " |

Note—In some of the above cases, notably the last two, the lehr could have been run much faster had the machine output demanded it.

We should like to thank the Hartford Empire Company, Hartford, Connecticut, U. S. A., who have developed this lehr, for their permission to publish the foregoing account and photographs, and would mention that the British rights have been acquired by the British Hartford-Fairmont Syndicate, Ltd., Audrey House, Ely Place, London, E. C. 1, the Continental interests being in the hands of Mr. J. H. O. Bunge, Watergate House, Adelphi, London, W. C. 2.

We understand that one of these lehrs is now being erected at the Greenford works of the Rockware Glass Syndicate, Ltd., and that the trade will shortly have an opportunity of inspecting it in actual commercial operation.

---

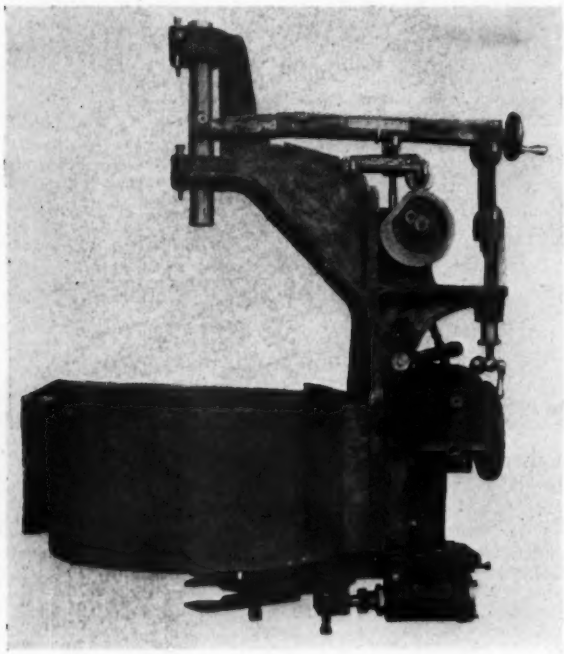
CATALOG OF THE CERAMIC LIBRARY. Central School of Science and Technology, Stoke-on-Trent, England. A catalog of approximately five thousand volumes, of which about four-fifths were brought together during a period of some forty years previous to his death in 1913 by Louis Marc Emmanuel Solon, a designer at Sevres and afterward connected with Minton's works in England. He was a well-established and recognized ceramic artist, connoisseur and critic. The Solon library, acquired from all parts of Europe, has been characterized as being unequaled anywhere and as constituting with the thousand-odd other books in the Central School of Science Library, the most complete ceramic library in existence.

# Glass Factory Equipment and Supplies

**Most of the information printed in this department comes direct from the manufacturers of the products described.**

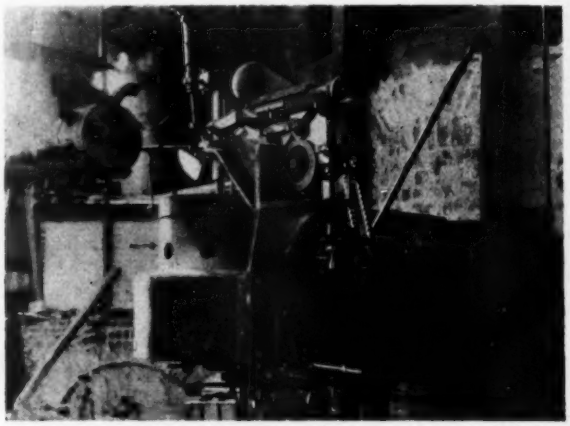
## Bethel Feeder Now on the Market

A new gob feeder of the plunger type is now being offered to the trade by the Bethel Engineering Company, builders of automatic knob and stopper machinery, Huntington Park, California. Its principal features are clearly shown in the accompanying illustrations. Simplicity in design and operation is the keynote of the invention. A. Rutledge Bethel, who developed the new machine, states that during several years' personal experience with various standard types of feeders he met with many troubles, the causes of which he has been able to eliminate to a large extent in the new design.



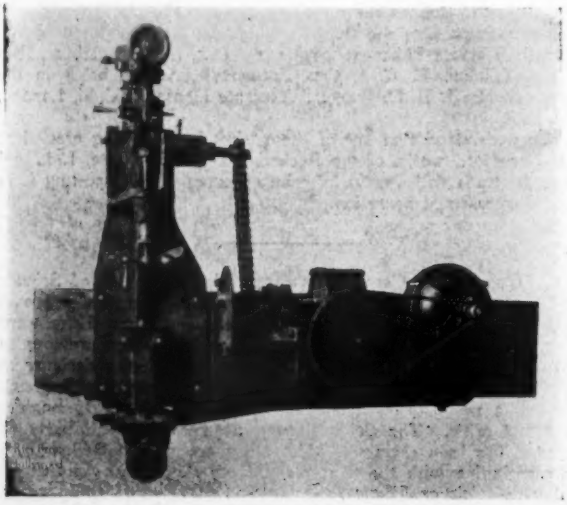
FRONT VIEW

One of the advantages claimed is perfect heat control, due to proper insulation and burner placement. The plunger is practically unbreakable. It averages about five weeks of actual service before replacement becomes necessary and eliminates, it is claimed, all lost time due to breakage during operations. The methods used for the adjustment of weight and the shape of drop are very simple and accurate. The machine is operated by a motor with a postive drive. The whole apparatus is compact and easily understandable even by unskilled workmen.



TYPICAL INSTALLATION, TYPE P

The first of the feeders put into commercial operation was built about one and one-half years ago for the Southern Glass Company, Los Angeles, manufacturers of milk and soda bottles, fruit jars, demijohns and packers' ware, etc., and four months later four more were installed, to which were added quite recently three more Bethel machines, five of the total number replacing other feeders which had been in operation about one year. A Bethel feeder has also been in successful operation for nearly a year



SIDE VIEW

INSTALLATION SHOWING OFFSET DELIVERY

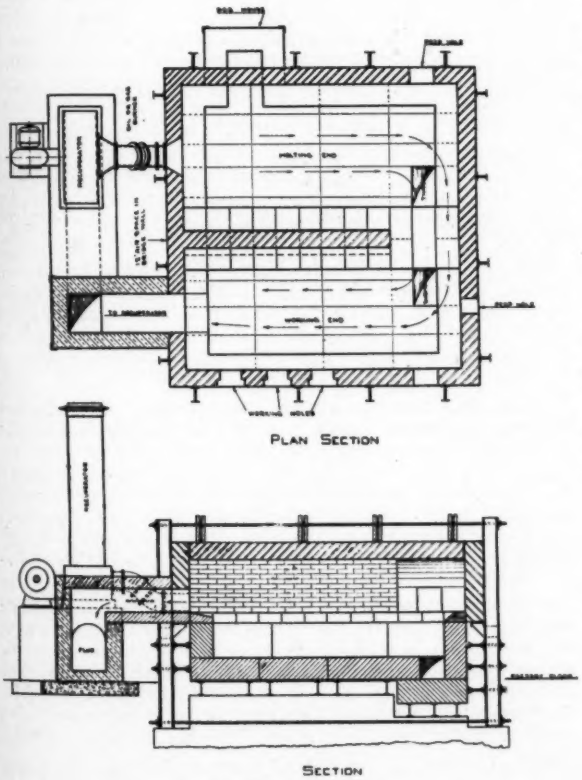
at the Monarch Glass Company, Florence, Cal., makers of carboys and demijohns.

The Bethel Engineering Company, build the feeders in their own well-equipped machine shop at Huntington Park, Cal. They state that in line with their policy their facilities enable them to put only the best of material and workmanship into their feeders, about which Mr. Bethel will be glad to supply further information to those interested.

## New Tank Embodies Novel Features

A continuous recuperative U-shaped glass melting tank which, according to the Simplex Engineering Company of Washington, Pa., who control the rights to build it, will melt a ton of crystal glass of tableware quality on 7 square feet of melting surface every 24 hours and consume only 8,000 to 10,000 cu. ft. of natural gas or its equivalent for each ton of metal melted, has been introduced to the trade.

The basic features of the design are clearly shown in the accompanying plan and cross-section. Built into the bridge wall which separates the melting and working ends is a 12-inch air




SIMPLEX "U" TANK

space. The throat is submerged. The depth of glass, 18 inches, tends to quick melting and the prevention of devitrification. This tank has only one-fifth the radiation surface of a tank of conventional design of equal capacity, a metal recuperator can be used with it, and, according to its sponsors, the cost of building it is 25 per cent. less than an equally productive tank of conventional design. They also state that besides crystal glass, it will melt colored glasses, opal and borosilicate and other special glasses. Its capacity as now built is from 2 to 10 tons every 24 hours and larger sizes can be built. It has been used with feeders.

Because of the shallowness of the body of glass quick changes can be made in the kind of glass melted, by tapping the tank, for instance, on a Saturday night and putting it back into blast on the following Monday morning. The builders claim the "U" tank to be the most flexible and economical glass melting unit available.

## Industrial Publications

**Chemical Engineering Catalog.** Tenth annual edition; 9 x 12 in.; 1,176 pages. Chemical Catalog Co., Inc., New York. Published under the auspices and supervision of the American Institute of Chemical Engineers, American Chemical Society and the American Section of the Society of Chemical Industry. The catalog is leased at $2 for one year to certain classifications of men interested in chemicals and the chemical industries, $10.00 a year to others. The catalog contains a comprehensive classified index of equipment and materials, manufacturers and "first-hand" sources, occupying nearly 300 pages; 745 pages of manufacturers' and dealers' specifications and catalogs of materials, supplies and equipment for the chemical industries, and a technical book section listing by subjects and authors about 130 pages of technical and scientific books obtainable from the Chemical Catalog Company, 19 East 24th Street, New York. The Chemical Engineering Catalog has functioned for years, successfully performing an important role throughout the chemical industries.

**Lubrication Bulletin.** Beach-Russ Company, 50 Church street, New York. Bulletin 34, an 8-page pamphlet describing briefly the company's line of rotary air compressors, compound and single stage vacuum pumps, high vacuum finishing pumps for exhausting electric light bulbs, vacuum bottles, etc., gas boosters, liquid handling pumps and automatic independent pressure water systems of 180 gallons per hour up to 2,000 gallons capacity. For each machine a specific kind of lubricating oil is recommended.

Attention is particularly directed to the engineering information on pages 22 to 24, and 57 to 60, on the calculation of speed and worm gear speed reducer problems. Also to the phantom shown on page 9 which graphically portrays the long lever arm principle employed in the design of IXL Spur Reducers.

The company will be pleased to furnish free copies on request, to plant executives and engineers.

**Trade Marks, Trade Names, Unfair Competition.** Fourth edition. A 48-page booklet treating of trade marks, their priority of adoption and use; validity, descriptive and suggestive marks, duration of rights, infringements, suggestions for selection, state and federal registration, patent office procedure and numerous related subjects. Issued by Richards & Geier, patent and trade-mark attorneys, 277 Broadway, New York. Copies of this booklet and another on "Patents, Law and Practice" will be sent gratis to interested readers.

**Modern Speed Reduction.**—Booklet issued by the Boston Gear Works Sales Company, at whose factory at Norfolk Downs, Mass., there is manufactured a large line of speed reduction units of the helical and worm types, Boston insulated flexible couplings and other products. The 36-page booklet contains a large amount of information concerning this line.

**Pressure Blowers and Exhausters.**—Bulletin No. 1608 was issued recently by American Blower Company, Detroit, Mich. A 16-page bulletin illustrating and describing some of this company's products and containing tabulated capacities, dimensions, etc. Certain types of A B C pressure blowers are used extensively in glass factories.

**Elimination of Waste—Simplified Practice.** Commercial forms—invoice, inquiry and purchase order. Bureau of Standards, United States Department of Commerce. Gives facsimile of standard forms as adopted by many commercial organizations and other information. Copies may be obtained at 5 cents each from Superintendent of Documents, Washington, D. C.

**Republic Water Meters,** Bulletin No. W-31, has been issued by the Republic Flow Meters Company, Chicago, Ill., who state that the subject of metering water electrically is not as well understood as it should be. The 16-page bulletin gives data on this subject.

**Lubrication,** published monthly by the Texas Company, New York, recently issued a number devoted to electric motors and their lubrication. Copies may be obtained upon application to the publicity department at New York.

# The Glass World and What It Is Doing

## News of the Industry

### H. L. Dixon Re-enters Refractories Field

The H. L. Dixon Company, Pittsburgh, Pa., have announced a new departure from their former policy in that H. L. Dixon, whose father was the pioneer in the field of refractories and who himself was associated in that business until he entered the engineering field, is returning with the H. L. Dixon Company into the refractories field. Mr. Dixon is a well known authority on clays and refractory materials. He will give his personal attention to the batches that go to make up the new Dixon blocks and glass manufacturers will now have available the old Dixon batches used by the pioneers in the business, and at the same time obtain the benefit of the long established technical service maintained by the Dixon engineering department.

### January Plate Glass Production

The January, 1926, production of polished plate glass in the United States amounted to 10,728,677 square feet, exceeding by just a small margin the previous high monthly record of 10,713,640 square feet made in October, 1925. In announcing these figures for the Plate Glass Manufacturers of America, Secretary P. A. Hughes made the comment that when consideration is given to the many obstacles a manufacturer is obliged to encounter during severe cold weather such as was experienced in January, the achievement is worthy of note.

### Sheffield Bottle Plant to Be Rebuilt

The contract for the design and construction of a complete new factory for the Sheffield Glass Bottle Company, Sheffield, Pa., to take the place of the one destroyed by fire the latter part of January at a loss of $450,000, has been awarded to the Simplex Engineering Company, Washington, Pa. The new plant will be of steel construction and will be equipped with a continuous tank, muffle lehrs, batch plant and all the usual accessories.

## Trade Activities

**The Carolina Glass & Door Company** has been incorporated at Raleigh, N. C., with a capital of $50,000 by Lawrence F. Tuck and J. S. Bryson.

**The American Window Glass Company's** plant at Kane, Pa., resumed operation on February 17 after being closed for repairs for about three months.

**The Merit Cut Glass Company,** Dunbar, W. Va., according to a press report, has been consolidated with the Dunbar Flint Glass Corporation, also of Dunbar.

Plans are in progress, it is reported, for the reopening of the Crescent plant of the **Interstate Window Glass Company** at Weston, W. Va., and operations are expected to be resumed about April 1.

**The Celite Products Company,** manufacturers of Sil-O-Cel for heat insulation, has removed their Los Angeles, Cal., offices from the Van Nuys Building to the Celite Building at 1320 South Hope street.

**Ball Brothers Company,** Muncie, Ind., it is reported, will spend about $60,000 on its Huntington, W. Va., plant which it acquired when the Schram Glass Manufacturing Company was taken over some time ago.

Robert J. Beler has recently joined the Pittsburgh sales office of **Foote Bros. Gear & Machine Company,** manufacturers of speed reducers, timing and other gears, 237-247 N. Curtis street, Chicago, as assistant to W. G. Kerr, district manager.

It was announced early in February that the earnings of the **Standard Plate Glass Company,** Pittsburgh, Pa., for the last quarter of 1925 showed a substantial profit in contrast to a deficit of $16,255 in the preceding quarter.

**The Hazel-Atlas Glass Company,** Wheeling, W. Va., quarterly statement issued January 28, showed a net gain of $356,601 for the three months ending December 26, 1925, before deducting the quarterly dividend of 2 per cent which was paid on January 2, 1926, amounting to $231,916.

At a meeting of the **Associated Glass and Pottery Manufacturers Association** Charles H. West was re-elected president and D. H. Cushwa, vice-president. C. L. Sebring was elected secretary, J. M. Hammer, assistant secretary, and G. S. Brush, treasurer.

**The Libbey-Owens Sheet Glass Company** on February 9 declared quarterly dividends of 1¾ per cent on the outstanding preferred stock of the company and 50 cents per share on the outstanding common stock payable March 1, 1926, to stockholders of record at 3 p. m. February 19.

**A new company** for polishing and preparing plate glass for mirrors, windshields, etc., according to a report from Clarion, Pa., was recently organized at Lucinda, near Clarion, Pa., by J. B. Vogelbacher, Maurice Schill, E. J. Carroll and J. E. Lander.

**The American Thermos Bottle Company,** Huntington, W. Va., is reported to be contemplating improvements to its plant which will double the present daily output of glass thermos bottle linings and which will include the construction of a 15-ton glass melting tank. George C. Anthon is general manager of the factory.

W. S. Walbridge was elected president of the **Kent-Owens Machine Company,** Toledo, O., at a recent meeting of the stockholders, to succeed E. L. Walbridge, who recently resigned on account of ill health. The other officers included the re-election of W. J. Donkel as vice-president and general manager; G. P. Greenhalgh, vice-president and treasurer, and F. L. Geddes, secretary. W. Rohr was appointed factory manager. The officers and E. L. Walbridge, H. Collin, and J. P. Cowell were elected directors.

A decree confirming the sale of the **Star Glass Company's** plant at Star City, W. Va., which went into the hands of a receiver over a year ago, was handed down recently in the circuit court at Morgantown, W. Va. The property was bought at public auction on January 30 by Louis A. Kauffeld, Jr., for $30,050. Various offers for it at lower prices had been made at auction sales before Mr. Kauffeld's bid was accepted.

An application to the Federal District Court in Pittsburgh by the Pittsburgh Trust Company to have a receiver appointed for the **Pittsburgh Lamp, Brass & Glass Company** was denied on January 23. The action related to an attempt to foreclose an $800,000 mortgage against the latter company held by the First National Bank of Pittsburgh. Judge Schoonmaker's decision was based on the fact that the Pittsburgh Lamp, Brass & Glass Company owns property valued at over a million dollars and has quick assets of over $500,000.

**The Bausch & Lomb Optical Company,** Rochester, N. Y., according to an announcement made by G. N. Saegmuller, vice-president, is planning a thorough reorganization which, it is said, will put younger men in active control positions. A few changes have already been made, including the appointments of M. H. Eisenhart, T. Drescher, J. H. Hammer, C. S. Bauser, J. F. Taylor and C. S. Hallauer as directors and active managers. Mr. Saegmuller, who has been with the company for many years, will be succeeded by Edward Bausch as general manager. It is not known what changes in this plan the recent death of President John J. Bausch will cause.

## Personals

**C. C. Leigh** has been appointed manager of the new department for the manufacture of glass advertising signs, gasoline filling station signs, etc., which was recently established by the Belmont Tumbler Company, Bellaire, O.

**J. T. Sloan,** for many years connected with the Owens Bottle Company, has, it is reported, acquired an interest in the Columbia Glass Company, Fairmont, W. Va. Mr. Sloan on March 1 assumed the duties of general manager of the concern.

**H. H. Baker** was recently appointed as assistant to J. C. Blair, president of the Libbey-Owens Sheet Glass Company, effective March 1. Mr. Baker has been treasurer of the Owens Bottle Company for the past few years, but has resigned to accept the new position.

**R. L. Frink,** Lancaster, O., the well known glass expert, sailed on the steamship "Olympic" on February 27 for Southampton and London, where he will stay a short while on private business. From London, Mr. Frink expects to proceed to Paris for the purpose of acquiring a new process of great value for the manufacture of molds and mold material. He will then proceed to Seville, Spain, on a mission to negotiate the purchase of a glass factory there. Mr. Frink expects to return to this country in about three months.

## Recent Deaths

### Paul Wissmach

Paul Wissmach, president of the Paul Wissmach Glass Company, with works at Paden City, W. Va., and office at Long Island City, N. Y., died on February 4.

### W. H. Hicks, Jr.

W. H. Hicks, Jr., secretary of the Fostoria Glass Company, W. Va., died on January 24 following a brief illness. Mr. Hicks, who was 44 years of age, was connected with the Fostoria company for many years, having started as an office boy. He was elected a few months ago to the position of secretary, following the resignation of A. Scroggin. He is survived by his wife and a son.

### John Jacob Bausch

John Jacob Bausch, founder and president of the Bausch & Lomb Optical Company, died at his home in Rochester, N. Y., on February 14 at the age of 95 years. Mr. Bausch was born in Germany, coming to this country when a young man. He made two unsuccessful attempts as a woodturner and at running an optical store in Rochester. Mr. Bausch discovered the adaptability of hard rubber for the making of spectacle frames and the demand for them finally aided him in maintaining his shop. He also succeeded in turning out lenses, said to be equal to those imported, and was the inventor of one of the first lens grinding machines to be used in America. In 1853 he was joined by his friend, Henry Lomb, in the foundation of the present concern, which is one of the largest lens manufacturing plants in the world. He is survived by his wife, two daughters and two sons.

## Coming Meetings

THE SECOND CHEMICAL EQUIPMENT AND PROCESS ENGINEERING EXPOSITION of the Association of Chemical Equipment Manufacturers will be held in Cleveland, May 10 to 15. A technical session devoted to the manufacture and use of ceramics will be held on Thursday, May 13.

THE SOCIETY OF INDUSTRIAL ENGINEERS will hold its thirteenth national convention at the Bellevue-Stratford Hotel, Philadelphia, June 16 to 18 inclusive. Papers and discussions will deal with practical methods for eliminating waste.

THE STAINED GLASS ASSOCIATION OF AMERICA, formerly the National Ornamental Glass Manufacturers Association, will hold its next annual convention next summer in Washington, D. C.

## What Our Advertisers Are Doing

**Wm. J. Miller, Inc.,** Swissvale, Pa., reports that the last of four additional Model RAB type machines were recently shipped to the Peltier Glass Company, Ottawa, Ill., making a total of eight of these machines installed by this company for the manufacture of colored toy marbles and lithographer's balls.

**The Chapman-Stein Furnace Company** announces that due to a steady growth in its furnace business during the past two years it has become necessary to enlarge its organization and to practically double the present office and drafting room space at Mt. Vernon, O. The company recently received large contracts for recuperative continuous furnaces, including two big furnaces for the Illinois Steel Company at South Chicago, Ill. In the glass industry the company is building a large number of recuperative tanks and pot furnaces. The Bartlett-Collins Glass Company will install an additional Chapman-Stein recuperator on one of their own 60" by 84" day tanks at Sapulpa, Okla. The first recuperator of this type was put into operation at the Bartlett Company several weeks ago.

## Inquiries Received

*For further information address:* THE GLASS INDUSTRY

317. We were interested in the article on Glass Chipping which appeared in your December, 1925, issue and would appreciate it if you could give us the names of manufacturers of equipment used in sandblasting and chipping.

318. Can you give us the name of a manufacturer who can make a glass ball 2¾ or 3 inches in diameter, which will not contain any blemishes. (Feb. 12).

319. Where can we procure glass bowls 16" diameter x 2½" deep to be used for guards over electric lights. (Feb. 10).

320. We understand that a large number of glass door knobs are being sold by the hardware trade. Kindly send us the names of all plants manufacturing this article. (Feb. 19).

## What the World Wants

*Specific inquiries for American goods received in the Department of Commerce*

England. 19118, opal glass.
Greece. 19137, glassware.
Bolivia. 18852, glass bottles and siphons.

## Glass Stock Quotations

PITTSBURGH STOCK EXCHANGE, FEBRUARY 23, 1926.

Reported by Moore, Leonard & Lynch, Union Trust Building, Pittsburgh, Pa.

| | Bid | Ask | Last |
|---|---|---|---|
| American Window Glass Machine, com | .. | 80 | 77 |
| American Window Glass Machine, pfd | 90 | 91 | 89½ |
| American Window Glass, pfd | .. | .. | 113 |
| United States Glass | 18½ | 18¾ | 18½ |
| Pittsburgh Plate Glass, com | 300½ | .. | 305 |
| Standard Plate Glass, com | 8¼ | 8½ | 8¼ |
| Standard Plate Glass: | | | |
| Preferred cumulative | 35 | 50 | 50 |
| Prior | .. | .. | 81 |

Glass stocks on the Pittsburgh Stock Exchange were moderately lower following the trend of other securities in February. Demand and trading was light.

WHEELING STOCK EXCHANGE, FEBRUARY 23, 1926.

| | Bid | Ask | Last |
|---|---|---|---|
| Hazel-Atlas | .. | .. | 42½ |
| Imperial | .. | .. | 72 |
| Fostoria | .. | .. | 150 |
| Central | .. | .. | 75 |

TOLEDO STOCK EXCHANGE, FEBRUARY 23, 1926.

| | Bid | Ask | Last |
|---|---|---|---|
| Owens Bottle Machine, com | .. | .. | 66 |
| Libbey-Owens Sheet Glass, com | .. | .. | 175 |
| Libbey-Owens Sheet Glass, pfd | .. | .. | 115 |

# Current Prices of Glass-Making Materials

**Quotations furnished by various producers, manufacturers and dealers.**

February 19, 1926

| | | Carlots | Less Carlots |
|---|---|---|---|
| Acid: | | | |
| Citric | lb. | .45 | .45 |
| Hydrochloric (HCl) 20° carb. ext. per 100 | lb. | .90 | 1.00 |
| Hydrofluoric (HF) 60% (lead carb.) | lb. | .. | .13½ |
| 52% and 48% | lb. | .. | .10-.11½ |
| Nitric ($HNO_3$) 38° carboy ext. Per 100 lb. | | 5.25 | 5 50 |
| Sulphuric ($H_2SO_4$) 66° | ton | 14.00 | 15.00 |
| Tartaric | lb. | .. | .29 |
| Alcohol, denatured | gal. | .42 | .60½ |
| Aluminum hydrate (Al $(OH)_3$) | lb. | .05 | .05½ |
| Aluminum oxide ($Al_2O_3$) | lb. | .. | .. |
| Ammonium bifluoride ($NH_4$) FHF | lb. | .. | .23 |
| Ammonia water ($NH_4OH$) 26° drums | lb | .. | .04 |
| Antimony, metallic (Sb) | lb. | .. | .21½ |
| Antimony oxide ($Sb_2O_3$) | lb. | .. | .19-.20 |
| Antimony sulphide ($Sb_2S_3$) | lb. | .. | .18 |
| Arsenic trioxide ($As_2O_3$) (dense white), 99% | lb. | 93½ | .04 |
| Barium carbonate ($BaCO_3$) | | | |
| Precipitated | ton | 44.00-50.00 | 47.00-54.00 |
| Natural powdered | ton | 42.00-44.00 | 45.00-46.00 |
| Natural, powdered, imported | ton | 38.00 | 40.00 |
| Barium hydrate ($Ba(OH)_2$) | lb. | .. | .05 |
| Barium nitrate ($Ba(NO_3)_2$) | lb. | .07¼ | .08 |
| Barium selenite ($BaSeO_3$) | lb. | .. | .. |
| Bone ash | lb. | .05½ | .06½ |
| Borax ($Na_2B_4O_7 10H_2O$) | lb. | .04¾ | .05-.05½ |
| Boric acid ($H_3BO_3$) | lb. | .09 | .09¾ |
| Refined | lb. | .10 | .10½ |
| Cadmium sulphide (CdS)— | | | |
| Red | lb. | .. | 1.25 |
| Orange | lb. | .. | 1.10-1.25 |
| Yellow | lb. | .. | .. |
| Chromium oxide ($Cr_2O_3$) | lb. | .30 | .31-.32 |
| Cobalt oxide ($Co_3O_4$) | | | |
| In bbls. | lb. | .. | 2.10 |
| In 10 lb. tins | lb. | .. | 2.20 |
| Copper oxide | | | |
| Red ($Cu_2O$) | lb. | .. | .30 |
| Black (CuO) | lb. | .. | .25 |
| Black prepared | lb. | .. | .30 |
| Cryolite ($Na_3Al\ F_6$) | lb. | .. | .09¼ |
| Epsom salts ($MgSO_4$) (imported) Per 100 lb. | | .. | 1.30 |
| Feldspar— | | | |
| 100 mesh | ton | 12.00-20.00 | 16.00-22.00 |
| 80 mesh | ton | .. | .. |
| 40 mesh | ton | .. | .. |
| Fluorspar ($CaF_2$)— | | | |
| Powdered white, 95% | ton | 40.00 | .. |
| " " 90% | ton | 38.00 | .. |
| Formaldehyde | lb. | .09 | .09½ |
| Graphite (C) | lb. | .. | .04-.07 |
| Iron oxide— | | | |
| Red ($Fe_2O_3$) | lb. | .. | .02 |
| Black (FeO) | lb. | .. | .. |
| Kaolin (f.o.b. mine) | ton | 10.00 | .. |
| English, lump, f.o.b. New York | ton | 13.00-23.00 | .. |
| Lead chromate ($PbCrO_4$) | lb. | .. | .. |
| Lead oxide ($Pb_3O_4$) (red lead) | lb. | .12¼ | .12½ |
| Litharge (PbO) | lb. | .11¾ | .12 |
| Lime— | | | |
| Hydrated ($Ca(OH)_2$) (in paper sacks) | ton | 12.50 | .. |
| Burnt (CaO) ground, in bulk | ton | 9.00 | .. |
| Burnt, ground, in paper sacks | ton | 11.00 | .. |
| Burnt, ground, in 280 lb. bbls. Per bbl. | | 2.15 | 2.30 |
| Limestone ($CaCO_3$) | lb. | .. | .. |
| Magnesia (MgO)— | | | |
| Calcined, heavy (in bbls.) | lb. | .04 | .04½ |
| light (in bbls.) | lb. | .22 | .24 |
| extra light (in bbls.) | lb. | .. | 37 |
| Magnesium carbonate ($MgCO_3$) | lb. | .06¼ | .06¾ |
| Manganese 85% ($MnO_2$) | lb. | .05 | .05½ |
| Nickel oxide ($Ni_2O_3$), black— | | | |
| for nickel content | lb. | .. | .35 |
| Nickel monoxide (NiO), green— | | | |
| for nickel content | lb. | .. | .35 |
| | | .. | 19.00 |
| Plaster of Paris, bags | ton | | |
| Potassium bichromate ($K_2Cr_2O_7$)— | | .08½ | .08¾-.10 |
| Crystals | lb. | .11 | .12 |
| Ground | lb. | | |
| Potassium carbonate— | | | |
| Calcined ($K_2CO_3$) 96-98% | lb. | .06½ | .06¾ |
| Hydrated 80-85% | lb. | .05¾ | .06 |
| Potassium chromate ($K_2CrO_4$) | lb. | .. | .27 |
| Potassium hydrate (KOH) (caustic potash) | lb. | .07⅛ | .07⅝ |
| Potassium nitrate ($KNO_3$) (gran.) | lb. | .06⅛ | .06⅝ |
| Potassium permanganate ($KMnO_4$) | lb. | .14½ | .15¼ |
| Powdered blue | lb | .. | .24-.26 |
| Rochelle salts, bbls. | lb. | .. | .20 |
| Rouge | lb. | .20 | .25 |
| Rutile ($TiO_2$) powdered, 95% | lb. | 20.00-22.00 | 23.00 |
| Salt cake, glassmakers ($Na_2SO_4$) | ton | .. | 2.10-2.15 |
| Selenium (Se) | lb. | .. | .47¼ |
| Silver nitrate ($AgNO_3$) | oz. | | |
| Soda ash ($Na_2CO_3$) dense, 58%— | | | |
| Bulk Flat per 100 lb. | | 1.35-1.40 | .. |
| Bulk, on contract Flat per 100 lb. | | 1.35 | .. |
| In barrels Per 100 lb. | | 1.69 | 2.40 |
| In bags Per 100 lb. | | 1.45 | .. |
| Spot orders .05 per 100 lbs higher | | | |
| Sodium bichromate ($Na_2Cr_2O_7$) | lb. | .06½ | .06¾ |
| Sodium hydrate (NaOH) (caustic soda) Per 100 lb. | | 3.10 | 3.76 |
| Sodium nitrate ($NaNO_3$)— | | | |
| Refined (gran.) in bbls. | lb. | .03⅞ | .04¼ |
| 95 per cent. Per 100 lb. | | 2.71 | 2.85 |
| Sodium selenite ($Na_2SeO_3$) | lb. | .. | 2.35 |
| Sodium fluosilicate ($Na_2SiF_6$) | lb. | .04½ | .05-.05½ |
| Sodium uranate ($Na_2UO_4$) | lb. | .. | 1.15 |
| Sulphur (S)— | | | |
| Flowers, in bbls. Per 100 lb. | | 3.35 | 3.65-3.90 |
| Flowers, in bags Per 100 lb. | | 3.00 | 3.30-3.55 |
| Flour, heavy, in bbls. Per 100 lb. | | 2.65 | 2.95-3.20 |
| Tin chloride ($SnCl_2$)) (crystals) | lb. | .. | .43 |
| Tin oxide ($SnO_2$) in bbls. | lb. | .. | .66 |
| Uranium oxide ($UO_3$), 100 lb. lots | lb | .. | .. |
| Zinc oxide (ZnO) | lb. | .07½ | .07¾ |

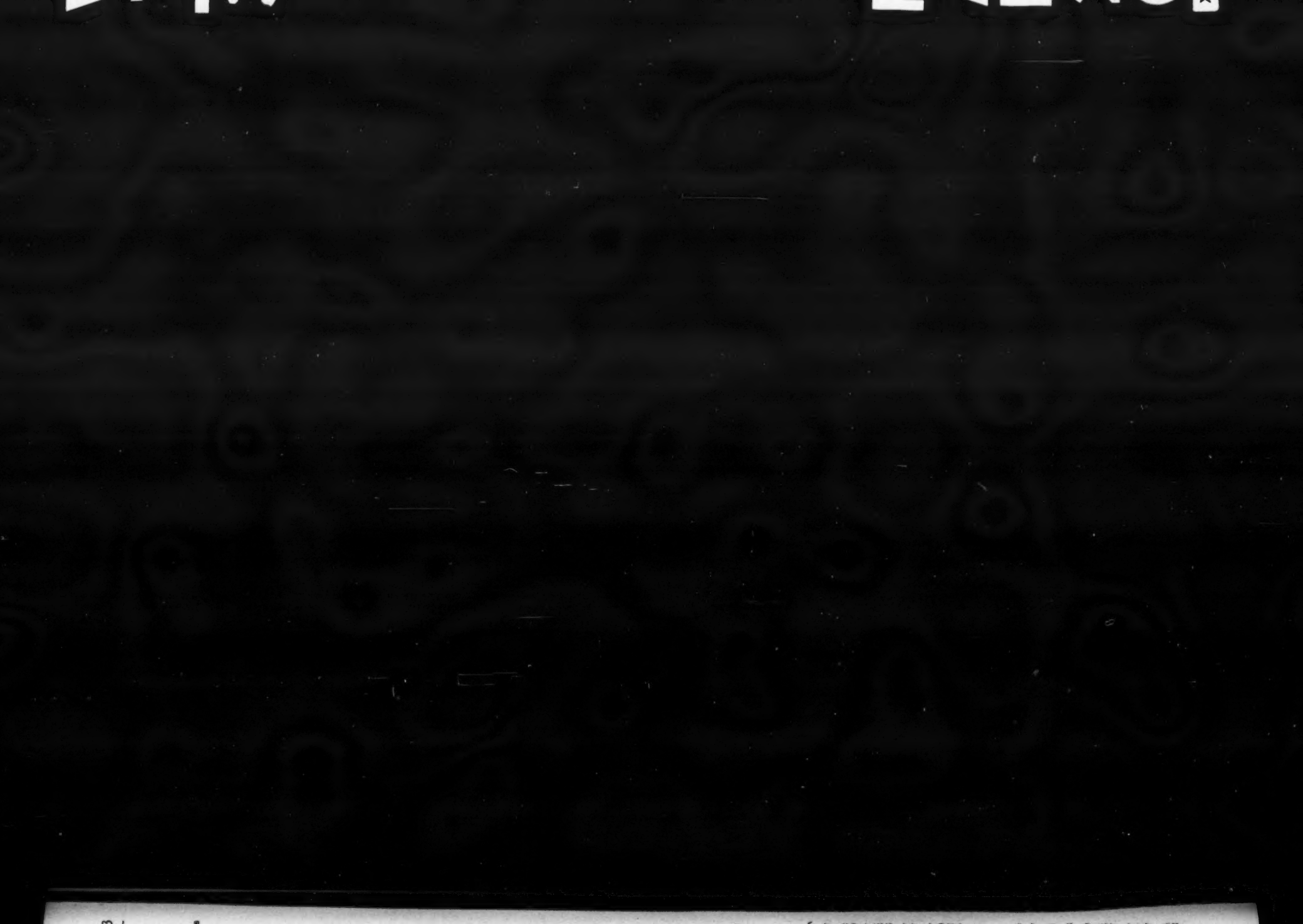
# Monthly Summary of United States Foreign Commerce in Glass

## EXPORTS

**Corrected to January 23, 1926**

| | December 1924 Quantity | December 1924 Value | December 1925 Quantity | December 1925 Value | Twelve Months Ending December 1924 Quantity | Twelve Months Ending December 1924 Value | Twelve Months Ending December 1925 Quantity | Twelve Months Ending December 1925 Value |
|---|---|---|---|---|---|---|---|---|
| Glass and glass products (total) | ..... | 626,287 | ..... | 897,089 | ..... | 8,716,134 | ..... | 8,807,237 |
| Plate and window glass— | | | | | | | | |
| Window glass, common, box 50 sq. ft. | 2,556 | 11,682 | 1,231 | 7,811 | 41,536 | 186,986 | 25,131 | 143,313 |
| Plate glass, unsilvered, sq. ft. | 205,356 | 41,055 | 194,686 | 40,100 | 1,809,300 | 516,163 | 1,578,657 | 407,440 |
| Other window and plate glass, n.e.s. lbs. | 199,380 | 18,506 | 185,567 | 17,950 | 2,105,976 | 221,268 | 2,447,333 | 272,891 |
| Glass containers (bottles, vials and jars) lbs. | 4,070,812 | 212,713 | 7,145,366 | 322,676 | 60,146,480 | 2,874,979 | 64,135,219 | 2,937,071 |
| Table glassware, plain lbs. | 1,099,673 | 124,637 | 1,741,640 | 167,528 | 16,355,229 | 1,764,556 | 17,442,847 | 1,753,628 |
| Table & other glassware, cut or engraved lbs. | 35,421 | 14,378 | 31,808 | 10,818 | 546,858 | 169,597 | 628,391 | 160,236 |
| Glassware for lighting— | | | | | | | | |
| Lamp chimneys and lantern globes lbs. | 164,166 | 25,925 | 169,181 | 39,705 | 1,931,153 | 353,334 | 1,867,673 | 356,417 |
| Globes and shades for lighting fixtures lbs. | 92,762 | 31,734 | 167,002 | 46,881 | 1,369,393 | 400,791 | 1,657,599 | 494,947 |
| Lamps and other illuminating devices, chiefly of glass lbs. | 88,425 | 23,781 | 107,515 | 25,011 | 1,026,545 | 304,764 | 893,854 | 227,267 |
| Chemical glassware lbs. | 15,928 | 11,803 | 19,122 | 20,451 | 238,195 | 190,666 | 226,798 | 196,790 |
| Electrical glassware, except for lighting lbs. | 75,336 | 9,161 | 159,097 | 17,451 | 2,390,662 | 241,558 | 2,664,380 | 269,962 |
| Other glassware, n.e.s. lbs | 371,138 | 100,912 | 1,258,802 | 180,707 | 8,281,985 | 1,491,472 | 8,875,223 | 1,587,275 |

## IMPORTS

**Corrected to January 23, 1926**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Glass (total) | ..... | 1,155,620 | ..... | 1,242,648 | ..... | 19,151,596 | ..... | 17,380,134 |
| Cylinder, crown and sheet— | | | | | | | | |
| Unpolished, lbs. dut. | 2,049,078 | 109,709 | 2,983,770 | 166,461 | 30,483,415 | 1,743,144 | 45,880,778 | 2,408,907 |
| Bent, ground, beveled, colored, painted, etc., and polished dut. | ..... | 34,391 | ..... | 46,980 | ..... | 511,789 | ..... | 535,378 |
| Plate Glass— | | | | | | | | |
| Unsilvered, sq. ft. dut. | 963,682 | 451,089 | 1,364,156 | 463,757 | 16,797,965 | 9,912,912 | 15,994,683 | 7,081,559 |
| Fluted, rolled, etc., or silvered, or containing wire netting, sq. ft. dut. | 188,735 | 32,992 | 40,574 | 5,915 | 2,575,353 | 366,691 | 1,262,372 | 195,950 |
| Containers—bottles, vials, etc. dut. | ..... | 14,174 | ..... | 17,650 | ..... | 206,942 | ..... | 185,811 |
| Table and kitchen utensils, lbs. dut. | 23,318 | 5,589 | 28,273 | 12,150 | 865,089 | 200,883 | 578,529 | 146,405 |
| Glassware, cut or decorated, lbs. dut. | 288,781 | 177,125 | 413,928 | 234,319 | 3,986,401 | 1,938,566 | 4,275,549 | 2,376,837 |
| Blown glassware, n.e.s.— | | | | | | | | |
| Bottles, ornaments, etc., lbs. dut. | 293,112 | 102,587 | 236,494 | 73,620 | 6,473,797 | 1,874,397 | 5,491,685 | 1,648,667 |
| Bulbs or electric lamps, number dut. | 1,129,238 | 12,313 | 1,227,550 | 12,476 | 15,089,581 | 198,793 | 16,929,550 | 175,417 |
| Chimneys, globes, shades, etc., lbs. dut. | 502,536 | 110,702 | 357,391 | 77,870 | 4,691,854 | 932,683 | 4,889,754 | 1,062,467 |
| Articles and utensils for chemical, scientific, experimental purposes lbs. | 53,798 | 21,633 | 104,439 | 42,276 | 970,501 | 332,161 | 975,419 | 379,924 |
| Other glassware dut. | ..... | 83,266 | ..... | 89,174 | ..... | 932,635 | ..... | 1,182,813 |